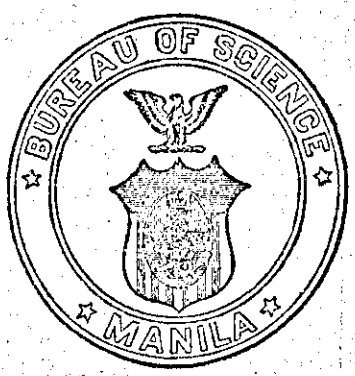
VOL. XIV, No. 2 FEBRUARY, 1919

THE PHILIPPINE JOURNAL OF SCIENCE



MANILA
BUREAU OF PRINTING
1919

THE PHILIPPINE
JOURNAL OF SCIENCE

VOL. XIV FEBRUARY, 1919 No. 2

PHLEBOTOMUS NICNIC, A NEW SPECIES, THE FIRST PHILIPPINE RECORD FOR THIS GENUS

By CHARLES S. BANKS[1]

(From the College of Agriculture, University of the Philippines, Los Baños)

ONE PLATE

Although the genus *Phlebotomus* has been recorded from India and Ceylon[2] no species of this genus has ever been noted as from the Philippines; in fact, casual collecting during a period of many years has resulted in the amassing of a considerable number of species of the Psychodidæ, none of which has been determined or described and among which there are sure to be found several new species in this very interesting group of the Diptera.

The present paper is written especially to bring to scientific attention a new species of the genus as a serious factor in human existence in this part of the world and as a not improbable agent in disease transmission.

For a number of years I have had accounts of a tiny fly which bites at night but which is "too small to be seen," and it was only after experiencing the bite of this pest in the summer of 1915 that I was able definitely to assign to a given fly the term "nicnic" which is the Tagalog name of a "tiny fly too small to be seen." I have therefore decided to give the vulgar name permanence as well as definiteness, by using it to designate a new species of *Phlebotomus* which was particularly abundant at the College of Agriculture campus about the middle of July in 1915 and which has been awaiting description since that time.

[1] Professor of entomology and chief of the department of entomology, University of the Philippines.

[2] Brunetti, E., Fauna Br. Ind., Dipt. Mem. (1912), 202.

164001

Phlebotomus nicnic sp. nov.

Male and female.—Grayish ochraceous to brownish buff, with slight silvery reflections at ends of some of the squamose hairs which so abundantly cover the body. Seen by transmitted light head and thorax are honey yellow, abdomen and legs are buff.

Head.—Long ellipsoidal to end of clypeus which is slightly concave basad, and inflated apicad, with numerous conical tubercles on its apical third. Proboscis one-half length of entire head. Palpi with first and second segments subequal, the former curved basad; third slightly longer and thinner, fourth and fifth subequal and nearly filiform, the latter bulbous basad. Antennæ with first segment cyathiform, second spherical, third three times length of fourth. Segments 3 to 10 slightly fusiform, segments 11 to 15 cylindrical, segment 16 obovoid fusiform. Each segment bears a subbasal regular whorl of curved hairs and other scattered groups most of which are three-fourths the length of the segment or longer than it. Eyes dark brown to black, nearly circular in outline and seven-eighths the occipitogular diameter. Hairs on head and thorax erect and of a length equaling the head diameter.

Thorax.—Pronotum a tiny squamose sclerite slightly proflexed over base of head. Distance, in profile, from mesonotal dorsimeson to apex of coxæ equal to length of abdomen. Length over mesonotum slightly less than this. Scutellum well rounded in profile, metanotum nearly plane. Upright hairs abundant.

Abdomen.—Cylindrical in male, slightly obovoid in female, with semierect hairs as long as the segments and evenly scattered over the tergites and sternites.

Legs.—Long, slender, coxæ and femora sparsely covered with long coarse hairs, femora, in addition, and remaining segments with a thickset covering of very fine recumbent downy hairs. Ungues rectangulate at their basal fifth, thence straight or scimitar-shaped apicad.

Wings.—Linear ovate or subspatulate, twice length of abdomen, their greatest width one-third their length in both sexes, very hairy on all veins, especially costa, sixth vein, and anal margin. Auxiliary vein ends midway between costa and first longitudinal, touching neither, but causing a decided curvature in latter. Petiole of first fork of second longitudinal equals anterior branch of fork. Fourth longitudinal forks at middle of wing. All veins except third longitudinal enter wing margin nearly perpendicularly, angulating before entrance. All veins about equidistant over wing surface. Both anterior and poste-

rior cross veins very evident, the former being at origin of third longitudinal and the latter at that of fifth. Seventh longitudinal not present or, if so, confused with fold in base of anal margin. Halteres very stout, with large, dark knob and paler stem.

Genitalia.—Hypopygium of male twice length of last abdominal segment, ventral styles fleshy, straight, or slightly curved, setose along sides and at rounded apex. Harpes asymmetrically spatulate and with four stout, curved spines along apex. Penis slender, constricted before apex which is obconical. Ovipositor of female with ventral lobes broadly ovoid and setose, dorsal lobes minute, setose.

Length.—Owing to the humpbacked attitude of this insect the measurements are taken from cephalic end of mesonotum to caudal end of abdomen and from tip of proboscis to dorsum of mesonotum.

Male: Thorax–abdomen, 1.083 millimeters; proboscis–thorax, 0.59; total, 1.673.

Female: Thorax–abdomen, 1.317 millimeters; proboscis–thorax, 0.85; total, 2.167.

Male: Length of wing, 1.44 millimeters; female, length of wing, 1.74.

LUZON, Laguna, Los Baños (*Charles S. Banks*).

Type.—Male and female, No. 18492 in entomological collection, College of Agriculture, Los Baños, P. I. Several additional specimens collected at the same time and place are labeled as paratypes.

The habits of this insect, which is a very vicious biter, are described in another paper dealing with the bloodsucking insects of the Philippines.

It is believed that the nicnic breeds in the kitchen drains of this vicinity, and as soon as time will permit an endeavor will be made to rear it.

ILLUSTRATION

PLATE I. PHLEBOTOMUS NICNIC BANKS SP. NOV.

FIG. 1. Head of female, showing peculiar clypeus, first segments of antennæ, and form of palpus.
2. Profile of clypeus, showing conical portions of hairs which have been left when main part has been broken off.
3. Apical segment of fore tarsus of female, showing rectangular ungues.
4. Antenna of male, showing three obconical distal segments.
5. Antenna of female, showing single obconical distal segment, much larger than that of male.
6. Wing denuded, showing peculiarities of venation.
7. Genitalia of male, profile.
8. Genitalia of female, profile.
9. Genitalia of female, ventral aspect, showing peculiar form of sternite of last abdominal segment.

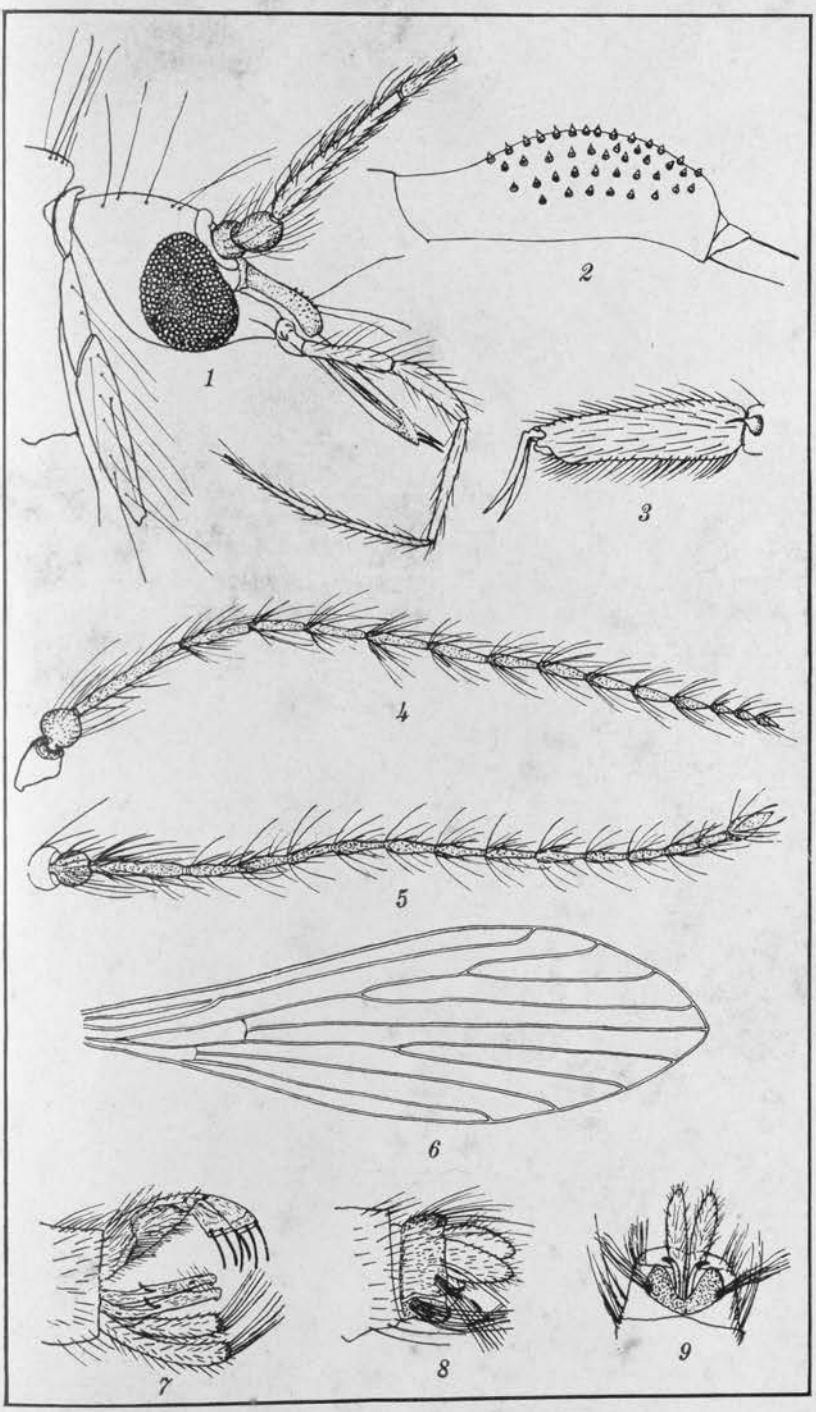


PLATE I. PHLEBOTOMUS NICNIC BANKS SP. NOV.

THE BLOODSUCKING INSECTS OF THE PHILIPPINES[1]

By CHARLES S. BANKS[2]

(*From the College of Agriculture, University of the Philippines, Los Baños*)

Insects and other arthropods that obtain all or a part of their sustenance from other animals during the whole or at some specific period of their lives are called parasites. Such parasites may be either facultative (that is, living for a part of their life upon other animals) or obligatory (requiring a continued existence on the host as a sine qua non of their own existence and propagation).

Confining this definition solely to insects, it may be stated that parasitism is not a faculty of any particular order or family of these organisms, but finds representatives among several orders that are only remotely related, so far as phylogeny is concerned.

The geological history of the Insecta plainly demonstrates that they were originally plant feeders, and that the habit of obtaining nutriment from animals, whether of their own class or of widely different phyla, is one that has been acquired during long ages of more or less intimate association among them, and between them and other animals.

Parasitism and predatoriness, especially the former, have been looked upon by some students as necessarily involving a condition tending toward, if not actually predisposing to, morphological degeneration of the parasite. But a casual glance at the various modifications of mouth parts, legs, wings, and even of the body itself will suffice to show that each of these modifications has tended toward a better adaptation of the insect to its special environment with the least amount of discomfort to its host and, therefore, with the greatest degree of security to itself.

BEDBUGS

The bedbug (*Cimex lectularius* L.), a universal companion of man though a very unwillingly accepted one, has its body

[1] Read at the twelfth annual meeting of the Asamblea Médico-Farmacéutica de Filipinas, February 9, 1918.

[2] Professor of entomology and chief of the department of entomology, University of the Philippines.

well adapted to living in the crevices of beds and of rooms, by being depressed almost to the thinness of paper in the unfed and nongravid conditions. Its prehensile proboscis, which it carries folded along the median line of the ventrum when at rest, can be easily thrust forward for tapping its prey without the insect itself being obliged to come near enough to risk accidental crushing by the sleeping victim.

All species of lice quickly succumb—in the tropics, at least—when removed from the warm environment of the host's body; but the bedbug, not being dependent upon the temperature factor, can endure long periods of isolation from the host, this being particularly true of the newly hatched nymphs before they have had a meal of blood. In the North Temperate Zone both nymphs and adults [3] have been kept in closed vials for as long as a year without apparent injury.

LICE

Body lice, head lice, and crab lice, living upon animals (man) whose hair is more or less recumbent, or who are provided with artificial covering in the form of clothing, have their bodies very markedly depressed, to enable them to glide readily from part to part of the host's body and still maintain a position favorable to the easy obtaining of food in the form of blood. All these insects have legs specially adapted to hair-clinging, the tarsal claws being reflexed upon the tarsi and provided with well-developed adductor muscles. The latter adaptation accounts for the necessity of "stroking" a head louse the length of the hair before it can be removed from its victim. A louse travels upon a single hair by means of the three legs on one side of its body. It will be observed that these legs are of the same length and almost identical in structure.

Two or more carabao lice, when placed on a hair suspended by its extremities, will be seen to travel from end to end of the hair, passing and repassing each other interminably with the greatest ease, without losing their hold.

The crab louse (*Phthirus pubis* L.), living among hairs that are stiffer and more nearly erect than those of the head, has a different morphological adaptation to its special needs. By means of the claws of the tarsi of its mid and hind legs it is enabled to grasp somewhat widely distant hairs on the body of the host. Pulling them toward each other, while it lies flat on the skin between them, it digs the claws of the tarsi of its

[3] *Insect Life* (1889–1890), 2, 105.

forelegs into the flesh. These two operations undoubtedly cause an irritation, which serves to bring more blood to the spot, decidedly to the advantage of the louse.

The manner of egg laying among the Pediculidæ is particularly well adapted to the life of absolute parasitism which they lead. Each egg, when laid, is fastened at its lower end to a hair by means of a band of glue, which completely encircles the hair and makes it impossible to remove the egg without first "stroking" it to the end of the hair. The young insect upon hatching grasps the hair and is ready to begin its existence. In the case of the body louse (*Pediculus corporis* de Geer), with which very fortunately the Philippines has not been infested during recent years, the eggs are fastened to the threads and seams of garments. The insects can only survive where woolen underclothing is worn and not changed with sufficient frequency to conform to the laws of hygiene. The best development of this insect has been manifested in the war camps of Europe and especially among the troops and other inhabitants of Servia, where it was shown to be the vector of typhus fever. An instructive account of the insect is given by Felt in his paper on household and camp insects.[4] The article gives the life history, habits, and means of control of this dangerous bloodsucking pest and contains an excellent bibliography of recent work done on it.

In addition to the lice found upon man in the Philippines, several animals harbor their respective species. The carabao louse (*Hæmatopinus tuberculatus* Nitzsch)[5] is too well known to need detailed description. It is sometimes found on carabaos in such great numbers as seriously to affect their general well-being. We are by no means certain that they do not serve as a means of transmission of the dread rinderpest. Young carabao calves, having longer hair than adult animals, frequently become infested by these lice to such a degree as to make shaving the hair necessary in order to alleviate their suffering. Submergence by the carabao has little or no permanent effect upon the insects, as the egg, the nymph, and the adult appear to be able to withstand a considerable stay under water. On the adult carabao they congregate upon the jowl, the neck, the shoulders, and other parts not easily affected by rubbing processes, while on the calves they are much more generally distributed.

[4] *Bull. N. Y. State Mus.* (1917), No. 194, 40 et seq.
[5] Insecta Epizoa (1875), 46.

The cattle louse (*Hæmatopinus eurysternus* Nitzsch),[6] though present, can scarcely be said to be abundant in the Philippines. Its habits are practically the same as those of the carabao louse, which it resembles. It may be distinguished from the former by the more strongly scalloped outline of its abdomen, the greater width of its thorax, and the longer tarsal claws.

Closely related to the above-mentioned species is the hog louse (*Hæmatopinus urius* Nitzsch) found throughout these Islands. It may be distinguished by its long slender legs with acutely curved tarsal claws mottled with dark brown, and by the black, strongly chitinous, lobed, lateral margins of the abdominal segments, the last of which is truncated and double-notched. The hog louse is slightly smaller than the cattle louse and more glabrous and transparent than either it or the carabao louse.

The goat louse (*Hæmatopinus stenopsis* Burm.) is fairly common on goats wherever they are found and was undoubtedly introduced with these animals just as the other species of the genus were brought in with their respective hosts. It is less than half as long as the cattle louse and very slender and is usually found gorged with blood.

Related to the goat louse is the rat louse (*Hæmatopinus spinulosus* Denny), which is common on these rodents when they are congregated in considerable numbers in bodegas and elsewhere. This insect is much smaller than the goat louse, of a uniform pale straw yellow, except when full of blood, and has a very much rounded face, with projects little beyond the antennæ.

Kellogg[7] has set forth the view, in discussing the biting lice (Mallophaga), that the same species of these parasites occurring on different species of birds argues the existence of a common ancestor for the latter. With equal reason we might assume that in other parasites, as the sucking lice, the closeness of their relationship might be further proof of the common ancestry of species now as widely separated as *Homo sapiens* L. and the other members of the Primates.

The monkey louse (*Pedicinus eurygaster* Gerv.), which is found on all monkeys in these Islands, bears a very close resemblance to the species of the genus *Pediculus;* in fact, the former differs only in having eight abdominal segments and five-segmented antennæ, while the latter has nine abdominal segments

[6] Op. cit., p. 45.

[7] American Insects. New York (1908), 117.

and three-segmented antennæ; *Pediculus*, according to Giebel,[8] having the apical segment composed of three ankylosed segments. The average monkey kept as a pet in the Philippines is rarely infested with this parasite. It is only when large numbers of the animals are confined together and when new wild ones are added from time to time that the colony becomes lousy. The habit of apparent depediculizing, often seen in individual monkeys, is therefore more reflex or instinctive than remedial.

FOREST FLIES

Another group of apparently obligatory bloodsucking parasites is composed of the so-called forest flies. These insects, belonging to the family Hippoboscidæ, of the Diptera, are extremely anomalous in their appearance. They are flat, leathery, louselike insects, with peculiarly shaped wings or none, and with tarsal claws well adapted to holding on to the wool, the hair, or the feathers of the mammals or the birds that they infest. The winged forms fly readily from one host to another, and it is stated that when a suitable host is found the flies, both male and female, dealate themselves,[9] presumably for greater convenience of motion through the pelage or plumage of the host.

Little is known of their life history, but it has been shown that the females of many species retain the single larva in the oviduct until it is fully grown and ready to transform to a pupa, when they deposit it.[10] At least five species are recorded from the Philippines, and there are some undescribed species in the Government collection.

BAT FLIES

Closely related to the forest flies, at least in general habits, are the bat flies, even more anomalous in their form than the Hippoboscidæ. There is no vestige of wings, the head is borne reflexed upon the dorsum of the thorax, and the long spiny legs and the body armature of spines, setæ, and hairs enable the insects to cling with great tenacity to the smooth hair of bats. Their life history is very similar to that of the forest flies according to Osten Sacken.[11] That they are obligatory parasites,

[8] Insecta Epizoa (1874), 32.

[9] *Trans. Ent. Soc. London* (1881), 360.

[10] Leuckart, *Abh. Ges. Halle* (1858), 4, 145; Pratt, *Arch. Naturges.* (1893), 59 (1) 151.

[11] Leuckart, *Abh. Ges. Halle* (1858), 4, 145.

their form and habits amply prove. Some undescribed species are in the Government collection.

Next in importance to the obligatory parasites among blood-sucking insects comes that class, the species of which obtain the blood of vertebrates in the adult stage, and whose larvæ find nutriment in decomposing vegetable or animal matter or among the minute plants of the waters where they breed. Chief among these are the mosquitoes (Culicidæ), the horseflies (Tabanidæ), the moth flies (Psychodidæ), the true flies (Muscidæ), the black flies (Simuliidæ), the midges (Chironomidæ), and the fleas (Pulicidæ), the last named breeding in dry rubbish in houses.

MOSQUITOES

Mosquitoes are so well known in the Philippines that much that might be said concerning their habits would be superfluous at this time; yet despite the wide distribution of these insects very few persons distinguish the many species as to place of breeding, time of appearance, manner of attack, and danger from their bite.

Five subfamilies of Culicidæ; namely, Anophelinæ, Megarhininæ, Culicinæ, Sabethinæ, and Chaoborinæ, are recognized by Bezzi [12] as being found in the Philippines, and he gives thirty-three genera including one hundred nine species. The species most commonly encountered are *Culex fatigans* Wied., the night mosquito; *C. microannulatus* Theob. and *C. ludlowi* Blanch., the salt-water mosquitoes; *Stegomyia persistans* Banks, the common tiger mosquito; *S. scutellaris* Walk., the white-lined tiger mosquito; *Myzomyia rossi* Giles, the common salt- and fresh-water malaria mosquito; and *M. febrifera* Banks,[13] the fresh-water malaria mosquito, found in running streams in the provinces, particularly those south of Manila. The last species was described since Bezzi's list was prepared. He does not include the grass-field mosquito, *Skusea diurna* Theob.,[14] which is abundant in Manila and its vicinity.

Other species, which at certain periods of the year may be veritable pests in the provinces, especially at Los Baños, are *Mansonioides uniformis* Theob.; *M. annulifera* Theob., the small woolly mosquito; *Theobaldiomyia gelida* Theob., the white-capped mosquito; and *Hulecœteomyia pseudotæniata* Giles, the rock

[12] *Philip. Journ. Sci., Sec. D* (1913), 8, 306.
[13] *Philip. Journ. Sci., Sec. D* (1914), 9, 405.
[14] *Entomologist* (1903), 36, 259.

mosquito, so-called from its habit of breeding in depressions in the bowlders of rocky streams where rain water collects.

One mosquito, though formidable in appearance, is beneficial in habit; this is the elephant mosquito, *Worcesteria grata* Banks,[15] which feeds only on fruit juices in the adult stage and, as a larva, destroys large numbers of the larvæ of noxious species.

HORSEFLIES

The horseflies are known wherever domestic or wild horses and cattle occur. They are fairly abundant in the Philippines and are of numerous species. At least one species, *Tabanus striatus* L., is abundant. Its life history is fully discussed by Mitzmain,[16] who also gives an excellent account of the blood-sucking habits of the adult.

These flies not only annoy domestic and wild animals, but they also attack human beings, especially children who may be asleep in the vicinity of cattle or horses. The species of the genus *Chrysops*, commonly known as deer flies, are annoying in the open forests of these Islands, and *Tabanus striatus* L. has been definitely proved to be a transmitter of surra.[17] Four genera and ten species are recorded from the Philippines.

MOTH FLIES

The moth flies (Psychodidæ) are extremely minute, woolly insects having the general appearance of tiny moths, due to the hairy covering of their wings, which are held out from the body at an angle of about 30 degrees. Few of these insects measure more than 2 millimeters in length and the average is about 1.5 millimeters. Most of the species found in the Philippine Islands belong to the genus *Psychoda*, the members of which do not suck blood, but at least one is a species of the genus *Phlebotomus*. The common Filipino name for this fly is *nicnic*, and I have used this as the specific name for the species, which is described in the preceding paper.

The nicnic is a very slender insect and does not exceed 2.2 millimeters in length. Its head is bent downward, giving it the humpbacked appearance common in this and related flies. Its gray, shaggy aspect causes it to blend perfectly with the color of the skin. Even when the pain produced indicates that a nicnic is biting the hand or the arm, it is extremely difficult

[15] *Philip. Journ. Sci., Sec. A* (1908), 3, 435.
[16] *Philip. Journ. Sci., Sec. B* (1913), 8, 197, Pls. I to VII.
[17] Ibid., 223.

to locate until it has become engorged with blood, an operation that takes from nine to fifteen minutes. At present nothing is known of its biology, though its larvæ have been sought for since it was first noticed in July, 1915, at the College of Agriculture, Los Baños, where it occurred in such large numbers as to be an annoyance to the entire community. It is so very small that it can easily crawl through the finest mosquito netting; and at the time of its great abundance, two and a half years ago, blood-filled specimens could be found in the upper corners of nets examined in the morning. Its time of first attack is from 7 to 8.30 o'clock in the evening, but it may be noted at almost any time that the sleeper awakes during the night. It is readily attracted to light, and hundreds of specimens were found crawling on lamp shades and bamboo walls near the electric lights.

This insect has been collected at no other place in the Philippines during sixteen years of entomological work, although the name "nicnic" has been heard frequently in connection with "a small, invisible insect that bites in the evening." Its bite is extremely severe, even more painful than that of most mosquitoes, and the wheal remains itchy for a day or more. If not satisfied with the first puncture, this fly will repeat the act four or five times within an area of a few square millimeters, and the bites are all equally painful. Each bite causes a distinct wheal, and sometimes the wheals overlap when fully formed. It is not definitely known whether or not both sexes bite; but, as their mouth parts are identical in structure, it is strongly suspected that they do.

That these insects might prove a factor in the spread of some disease is highly probable, on account of their great abundance at times and of their persistent manner of attack.

TRUE FLIES

The true flies (Muscidæ), as bloodsuckers, number at least five species in three genera in the Philippines. The genus *Stomoxys* contains two species, *S. calcitrans* L. and *S. nigra* Macq. The former, commonly called the stable fly or biting house fly, is by far the commonest bloodsucking fly found in these Islands. It is a cosmopolitan species and so closely resembles the common house fly (*Musca domestica* L.) that the latter is very frequently supposed to be a bloodsucking species.[18]

The larvæ of this fly feed on a great variety of decom-

[18] *Bull. N. Y. State Mus.* (1917), 194, 20.

posing animal and vegetable substances; Mitzmain,[19] who has worked out their life history in the Philippines, says that ordinary wet filter paper served as food for them.

The bite of the adults is very painful, but its effects soon pass. Clothing such as is worn in the tropics is no impediment to their attacks. They frequently bite through stockings or through a shirt and undershirt. Bare-legged children, especially when sleeping, are common victims of their attacks, as are also cattle and horses which they annoy very greatly, especially in the city of Manila, where they are exceedingly abundant. They do not restrict their feeding to these animals but will also bite monkeys, carabaos, goats, sheep, guinea pigs, cats, deer, dogs, rabbits, chickens, bats, rats, and lizards, at least under experimental conditions.[20]

The cattle fly (*Lyperosia exigua* de Meij.) is a common pest of bovine animals throughout the Islands. It congregates in hundreds upon every part of the body of work cattle and causes them an endless amount of annoyance. The swarms on one side of an animal simply transfer to the other side at the approach of an observer, but they do this with no special hurry, particularly when partially filled with blood. The coat of a cow will frequently be found to be matted with dried blood, which in some cases has exuded after the withdrawal of the insect's proboscis; in others it is the bloody fæcal matter voided by these little gluttons in the act of almost continuous feeding for an hour at a time. The insects remain upon the host when not feeding, simply resting upon the extremities of the hairs; but, when about to suck blood, they of necessity bury themselves deeply into the hairy coat, and nothing remains visible except the tips of their wings. The fact that they breed in cow and carabao dung, laying their eggs within a few minutes of the time it is voided, makes combatting them extremely difficult here.

Both of these genera are somewhat closely related to the deadly tsetse fly (*Glossina* spp.), of Africa, and might well play a rôle similar to that of the latter.

Two other species of bloodsucking flies, belonging to the genus *Philaematomyia*, namely *P. crassirostris* Stein and *P. inferior* Stein, are closely related to the genus *Musca*, and are reported from the Philippines as attacking cattle. They are related to *P. insignis* recorded from tropical Africa and the Oriental Region, a valuable account of the mouth parts of which

[19] *Philip. Journ. Sci., Sec. B* (1913), 8, 29.
[20] Mitzmain, *Philip. Journ. Sci., Sec. B* (1913), 8, 41.

has been given by Cragg,[21] who also describes [22] the mouth parts of *Lyperosia minuta* Bezzi, which is related to our species.

BUFFALO GNATS

The black flies (Simuliidæ) are represented in the Philippines only in the mountains, where they are extremely annoying to travelers, getting into their eyes, nostrils, and ears, and severely biting any exposed portions of their bodies. They are sometimes called buffalo gnats, from their former abundance on the plains of the United States where the buffalo, or bison (*Bison americanus*), once roamed. A few specimens of the genus *Simulium* in the Government collection were taken on one of the peaks of Canlaon Volcano, Occidental Negros, in 1906. This genus seems to be of world-wide distribution, and its ill favor in Europe and America is well warranted by the damage it does.[23]

MIDGES

The midges (Chironomidæ) are abundant in the Philippines, where the genus *Culicoides*, represented by *C. judicandus* Bezzi, is one of the commonest and most annoying pests in provincial regions. It is very persistent at certain times of the year, especially in Los Baños, where the mountain streams undoubtedly supply its breeding places. According to de Meijere,[24] Jacobson in Java found that its bite does not disturb sleeping persons or cause a subsequent itching, but certainly this is not the case in these Islands. He further states that these insects are to be found in chicken houses at night, where they cause great unrest among the fowls. A white hen was noticed with the feathers covered with drops of blood drawn by these midges. It was further observed that at Samarang, Java, they were most abundant during the times of heaviest rainfall. This coincides with observations made in the Philippines; the year 1917 was unusually rainy, and these little pests were extremely abundant at that time. Their small size and mottled wings serve as a protection when they alight on the bare arm or leg of a person, and they readily enter mosquito nets where, like the nicnic, they congregate in the upper

[21] *Sci. Mem. Off. Med. & San. Corps*, Govt. of India (1912), No. 54 (N. S.).

[22] Ibid. (1913), No. 59 (N. S.).

[23] Williston, S. W., North American Diptera, 2d ed. New Haven (1908), 146.

[24] *Tijdsch. voor Ent.* (1909), 52, 195.

corners when replete with the blood of their victims. Their bite is as painful as that of the nicnic, but the effects last longer and the redness of a bitten spot will remain for two or three days, while the slightest irritation will cause it to begin itching again.

FLEAS

Fleas (Siphonaptera) have been considered by some authors as a suborder of the Diptera.[25] Their metamorphoses would tend to indicate this and their wingless condition has its counterpart in certain Diptera, for example, the Phoridæ.

Fleas, living upon animals whose hair is more or less semierect, are very strongly compressed, so that they can easily travel through the mass of hairs and still maintain an attitude in which their suctorial mouth parts are at right angles to the skin that they puncture. Their bodies and legs are extremely smooth and are armed with strong spines, or setæ, pointing caudad and distad, so that the slightest effort causes a forward movement and gives an excellent chance for escape even when caught between the teeth or the fingers of their permanent or temporary hosts. Their well-developed, saltatory hind legs make it easy for them to spring from the ground to their hosts or from host to host. Their hard chitinous integument protects them from being crushed, while their specially developed claws, or ungues, enable them to hold on to the hairs or the skin of the host.

The adult flea lives habitually upon warm-blooded animals. The female drops her eggs to the floor, where they are brushed into crevices and where the grublike larvæ feed upon dust, dried blood particles, fæcal matter, and other filth, and among which they spin their cocoons for transformation to pupa and adult. The newly emerged adults then hop upon the mammalian host to begin their period of parasitism.

The Philippines proves no exception to the rule that wherever man is found, with his congested habitations and his variety of domestic animals, there will be found an abundant supply of these annoying and dangerous pests. The superabundance of dogs and cats in all parts of the Archipelago accounts for the great numbers of dog and cat fleas (*Ctenocephalus felis* Bouché), while the many warehouses, old dwellings, and ill-designed newer ones in Manila and other large cities furnish harbors for hundreds of thousands of rats upon which the

[25] Folsom, J. W., Entomology with Special Reference to its Biological and Economic Aspects, 2d rev. ed. P. Blakiston's Son & Co., Philadelphia (1913), 19.

dangerous plague flea (*Læmopsylla cheopis* Rothsch.) prefers to live. That the plague flea does not confine itself to this host, the terrible outbreaks of human plague in this and other countries too well have testified, since it is the only known medium for the transmission of this deadly malady from the rat to man.

The so-called human flea (*Pulex irritans* L.) is rarely met with in the Philippines, and as specimens have been taken only in Manila and Iloilo it is presumed that they are brought here by steamers.

It will be seen that all the insects discussed in this section, including flies and fleas, are semiobligatory parasites that in the adult stage require the blood of vertebrates but live apart from the host as larvæ.

Another interesting insect is the red-banded cone-nose (*Conorhinus rubrofasciatus* de Geer), which has been recorded from the Oriental Region, Africa, and America, and is closely related to insects of similar habit in the United States and Brazil. One of its common names in the United States is bedbug hunter, as it is known to suck the blood which these pests have taken from the human host. From this habit has naturally resulted the taking of blood directly from the sleeping host, and at least one case is known of a student in Manila who was bitten by these insects. In June, 1914, an adult and a half-grown larva were sent to my office by the Director of Health; the specimens were full of human blood, and one had been crushed by the person bitten.

It is stated by Herrick [26] that a person bitten by the American species (*Conorhinus sanguisugus* Le Conte) did not recover for more than a year.

These insects are so large and conspicuous, measuring from 18 to 20 millimeters in length, that it is strange they are not reported more frequently; but they escape detection undoubtedly because they are very quick fliers and are nocturnal in their habits. They cannot of course penetrate a well-kept mosquito net, but could easily crawl under one that is torn or carelessly adjusted.

A close relative in Brazil (*Conorhinus megistus* Burm.) is the transmitter of a deadly human trypanosome (*Schizotrypanum cruzi* Chagas); [27] an admirable account of its life history and habits has been given by Neiva.[28] The Philippine species should be looked upon with suspicion so far as disease transmission

[26] Household Insects. New York (1914), 422.
[27] *Mem. do Inst. Osw. Cruz* (1909), 1, 159–218, 4 pls.
[28] In Chagas, loc. cit.

is concerned, and living material should be studied from a protozoölogical standpoint.

The list of occasional bloodsucking insects includes those species in diverse orders and families which, while normally either plant feeders or predatory on other insects, will under exceptional conditions attack vertebrates, either piercing them severely or sucking their blood. Among these are the assassin bugs (Reduviidæ), represented by many genera and species and comprising some of the insects most beneficial to agriculture because of their habits of feeding on injurious insects.

The assassin bug most commonly met with in houses is *Ectomocoris atrox* Stål, which is attracted to light in considerable numbers and which inflicts a bite like the puncture of a red-hot needle with its sharp, horny proboscis, if disturbed when crawling over the body. Very little swelling accompanies the bite, but the pain lasts several hours or even days; and not infrequently suppuration, due to infection at the time or subsequently, causes a sore similar to a boil. The resulting scar has the appearance of a smallpox pit, even to the whiteness. As some of these insects are known to suck the juice of carrion, it is highly probable that infection may be caused by deleterious matter injected mechanically when they bite.

Two other species of this genus, *Ectomocoris flavomaculatus* Stål and *E. biguttulus* Stål, are occasionally met with; but neither of them has been known to attack man unprovokedly. Among other dangerous or unpleasant members of this family may be mentioned *Sycanus ståli* Dohrn, *Eulyes illustris* Stål, and *Sphodronyttus erythropterus* Burm., which are merely representative of a large class with similar habits, not naturally aggressive to higher animals, but always ready to assert their rights when molested or even occasionally to intrude upon the rights of others. The red-banded cone-nose described above is one member of this family that appears to have departed entirely to the side of parasitic aggressors.

Somewhat remotely related to the Reduviidæ is a group of insects of the same order, but of a different suborder, and known as leaf hoppers. They are primarily and preëminently plant feeders, but occasionally the tiny green *Nephotettix apicalis* Motsch or *N. bipunctatus* F. will alight upon, and suck blood from, the bare hand or arm of the observer at night when large numbers of these insects are attracted to light. They are most abundant at the end of the rainy season, and as many as two liters have been collected at a light in Manila on a single damp night.

WATER BUGS

At least five species of water bugs merit our attention here because of the more or less severe bite that they can inflict. In the order of their size and importance, these are: *Belostoma indica* St. F. et Serv., the giant water bug, sometimes called the electric-light bug; *Laccotrephes robustus* Stål and *Ranatra parmata* Mayr, the water scorpions; *Sphaerodema rusticum* Fab., the diver; and *Micronecta quadristrigata* Bredd., the small back-swimmer. The first of these kills small fishes and then sucks their blood. It can cause great pain, if handled so carelessly as to permit it to pierce the finger with its sharp beak. The next three are only harmful when carelessly handled, and they feed principally on insects. The fifth is attracted to light and will, like *Nephotettix*, bite a person that may be near the light.

ROBBER FLIES

Of the same character as the foregoing as to habits might be mentioned the robber flies, belonging to the families Mydaidæ and Asilidæ. Their species are numerous in the Philippine Islands, and individuals are abundant on every sunny roadside. They are the most extensively predaceous of any flies, and while the largest Philippine species rarely exceed 30 millimeters in length, they do not hesitate to capture and suck the fluids from other flies, bees, wasps, beetles, and even moths and butterflies. They are only known to bite man when captured and carelessly handled, but the bite is painful in the extreme and they might well develop a marked bloodsucking tendency.

THRIPS

The thrips, small fringe-winged insects (Thysanoptera), often are almost microscopic, and the largest rarely exceed 7 or 8 millimeters in length; they feed habitually upon the juices of plants, the leaves of which they cause to curl at the edges, thus forming a retreat for their young. One species of this order has a decided predilection for human blood, and a sharp bite on the hand during the middle of a hot, sunny afternoon can almost always be attributed to these minute insects, especially if one be resting near a tree in an open field. The bite of these insects causes no further inconvenience than the momentary pain, which vanishes almost with the culprit, no swelling or itching being produced.

TICKS

It would hardly be proper to close this paper without reference to a class of arthropod animals which, while it cannot be

included among the insects strictly speaking, contains species most of which are highly important from an economic as well as a morphologic and biologic standpoint. This class includes the mites and ticks and is closely related to the spiders. All of the ticks and many of the mites are bloodsucking arthropods, and they infest both man and the lower animals in these Islands.

The most important is the cattle tick, *Margaropus australis* Fuller (synonym, *Boophilus*), an account of which was given by me several years ago.[29] That its effect upon the health and general welfare of our cattle is deleterious can hardly be gainsaid, and its habits are such as to make its eradication difficult. The eggs are laid on the ground by females that have dropped from the host for this purpose. The young, when hatched, crawl to the tops of plants and gain easy access to passing animals upon which they fasten themselves for engorgement.

The dog tick (*Dermacentor variabilis* Say) will attack not only dogs but also cattle, horses, rabbits, and man. Children who are allowed to play on the floors where dogs lie, or with these animals, are sure to get the ticks between their toes and fingers and elsewhere upon their bodies.

The males when fully grown are seldom over 2.5 millimeters in length, while the females, like those of the cattle tick, attain a length of 10 to 12 millimeters and are shaped almost exactly like the seed of the castor plant (*Ricinus communis* L.); so much so that some authors have called the order Ricini instead of Acarina.

Excellent accounts of ticks, as well as mites, are given by N. Banks,[30] who describes in a very enlightening manner many species from all parts of the world.

In the Philippines, as in several other parts of the world, man is infested by a small, red mite, known in many portions of this country as *tungao*. This mite affects the axilla, groin, and other portions of the body where the skin folds upon itself, and causes extreme annoyance by its burrowing mouth parts. The Philippine species is undoubtedly a *Trombidium*, but if it be closely related to the Japanese river-fever, or kedani, mite [*Leptus akamushi* (Brumpt)], which in Japan causes a rather severe fever among rice harvesters and those who work in river lands, is not known, owing to lack of sufficient material from both countries.

[29] *Bur. (Philip.) Govt. Laboratories* (1904) No. 14, 13.
[30] *Rep. U. S. Dept. Agr., Off. Secy.* (1915), No. 108.

The foregoing does not include every species of bloodsucking insect of these Islands, and new facts are coming to light daily with reference to our rich insect fauna. Work in this line can be greatly aided by coöperation on the part of medical practitioners and those connected with sanitation, who have opportunities for collecting useful data and specimens known to have, or suspected of having, the habits set forth above.

LIST OF BLOODSUCKING INSECTS OF THE PHILIPPINES, ACCORDING TO THEIR NATURAL ARRANGEMENT

ARACHNIDA

ACARINA

IXODOIDEA

IXODIDÆ

Margaropus australis Fuller. C. S. Banks, P. I. Bur. Govt. Laboratories (1904), No. 14, 13.

Dermacentor variabilis Say. N. Banks, Report U. S. Dept. Agr., Off. Secy. (1915), No. 108, 67.

TROMBIDIODEA

TROMBIDIIDÆ

Trombidium spp. N. Banks, Report U. S. Dept. Agr., Off. Secy. (1915), No. 108, 42.

INSECTA

HEMIPTERA-APTERA

PEDICULIDÆ

Pediculus humanus Linn., 1758. Giebel, Insecta Epizoa (1874), 30.
Pedicinus eurygaster Gerv. Giebel, Insecta Epizoa (1874), 32.
Phthirus pubis Linn., 1758. Giebel, Insecta Epizoa (1874), 23.
Hæmatopinus eurygaster Nitzsch. Giebel, Insecta Epizoa (1874), 41.
Hæmatopinus stenopsis Nitzsch. Giebel, Insecta Epizoa (1874), 44.
Hæmatopinus spinulosus Nitzsch. Giebel, Insecta Epizoa (1874), 38.
Hæmatopinus tuberculatus Nitzsch. Giebel, Insecta Epizoa (1874), 46.
Hæmatopinus urius Nitzsch. Giebel, Insecta Epizoa (1874), 45.

HEMIPTERA-HETEROPTERA

CIMICIDÆ

Cimex lectularius Linn. Herrick, Household Insects (1914), 122, for bibliography.

REDUVIIDÆ

Conorhinus rubrofasciatus de Geer. Stål, Oefv. Vet. Akad. Forh. (1870), 693.
Ectomocoris atrox Stål, Oefv. Vet. Akad. Forh. (1870), 692.
Ectomocoris biguttulus Stål, Oefv. Vet. Akad. Forh. (1870), 692.
Ectomocoris flavomaculatus Stål, Oefv. Vet. Akad. Forh. (1870), 692.
Eulyes illustris Stål, Oefv. Vet. Akad. Forh. (1870), 681.
Sycanus fulvicornis Dohrn, 1866. Stål, Oefv. Vet. Akad. Forh. (1870), 681.

Sycanus ståli Dohrn, 1866. Stål, Oefv. Vet. Akad. Forh. (1870), 681.
Sphodronyttus erythropterus Burm., 1834. Stål, Oefv. Vet. Akad. Forh. (1870), 684.

HEMIPTERA-HOMOPTERA

BELOSTOMIDÆ

Sphærodema rustica Fabr. Stål, Oefv. Vet. Akad. Forh. (1870), 706.
Belostoma indica St. F. et Serv. Stål, Oefv. Vet. Akad. Forth. (1870), 706.

NEPIDÆ

Laccotrephes robustus Stål, Oefv. Vet. Akad. Forh. (1870), 706.
Ranatra parmata Mayr, 1866. Stål, Oefv. Vet. Akad. Forh. (1870), 707.

NOTONECTIDÆ

Micronecta quadristrigata Bredd.

SIPHONAPTERA

PULICIDÆ

PULICINÆ

Læmopsylla cheopis Rothsch. Herrick, Household Insects (1914), 161. For bibliography of fleas, see Rothschild, Ent. Mo. Mag. II, (1903), 14, 85.
Pulex irritans Linn. Baker, Proc. U. S. Nat. Mus. (1905), 29, 142.
Ctenocephalus canis Curtis. Baker, Proc. U. S. Nat. Mus. (1905), 29, 131, 145.
Ctenocephalus felis Bouché=*C. canis*, q. v.

DIPTERA

PUPIPARA

Hippobosca equina Linn., 1758. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 59.
Hippobosca maculata Leach, 1917. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 59.
Olfersia nigrita Speis., 1905 Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 311.
Ormittroctona nigricans Leach. Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 311.

BRACHYCERA

TABANIDÆ

Tabanus spp. Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 308.
Tabanus rubidus Wied., 1821. Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 312.
Tabanus striatus Fabr. Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 312; Mitzmain, Philip. Journ. Sci., Sec. B (1913), 8, 197 (life history and disease transmission).
Chrysops signifer Walk., 1861. Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 312.
Ommatius chinensis Fabr., 1794. Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 313.
Laphria dimidiata Macq., 1846. Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 313.

MUSCIDÆ

Philæmatomyia crassirostris Stein, 1903. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 29.

Philæmatomyia inferior Stein, 1909. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 29.

STOMOXINÆ

Lyperosia exigua de Meij., 1903. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 30.

Stomoxys calcitrans Linn., 1758. Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 315; Mitzmain, Philip. Journ. Sci., Sec. B (1913), 8, 29 (life history).

Stomoxys nigra Macq., 1851. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 30.

ASILIDÆ

Twenty-four species enumerated in 10 genera. Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 303.

Philodicus longipes Schiner, 1868. Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 313.

Mydas fruhstoferi v. d. Wulp, 1896. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 21.

Leptogaster princeps O. S., 1882. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 21.

Saropogon rubricosus Bezzi, Philip. Bur. Sci. Pub. (1916), No. 10, 21.

Saropogon specularis Bezzi, Philip. Bur. Sci. Pub. (1916), No. 10, 22.

Xenomyza vitripennis O. S., 1882. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 23.

Damalina semperi O. S., 1882. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 23.

Orthogonis scapularis Wied., 1828. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 24.

Anisosis phalaris O. S., 1882. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 24.

Pogonosoma cyanogaster Bezzi, Philip. Bur. Sci. Pub. (1916), No. 10, 24.

Smeringolaphria alternans Wied., 1828. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 24.

Epholchiolaphria aurifascies Macq., 1848. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 24.

Epholchiolaphria leucoprocta Wied., 1828. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 24.

Epholchiolaphria partialis Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 24.

Epholchiolaphria vulcanus Wied., 1828. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 23.

Promachus bifasciatus Macq., 1838. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 26.

Promachus forcipatus Schiner, 1868. Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 26.

Myiophthiria reduvioides Rond., 1878. Bezzi, Philip. Journ. Sci., Sec. D (1913), 8, 311.

CHIRONOMIDÆ

Culicoides judicandus Bezzi, P. I. Bur. Sci. Pub. (1916), No. 10, 8.

PSYCHODIDÆ

Phlebotomus nicnic Banks. Antea, 164.

CULICIDÆ

For species of Culicidæ of the Philippines, see bibliography under C. S. Banks and C. S. Ludlow.

PARTIAL BIBLIOGRAPHY OF BLOODSUCKING INSECTS

[Fuller bibliographies will be found in the volumes that are marked by an asterisk.]

BANKS, C. S. The Australian tick (Boophilus australis Fuller) in the Philippine Islands. *P. I. Bur. Govt. Laboratories* (1904), No. 14.

* IDEM. A List of Philippine Culicidæ, with descriptions of some new species. *Philip. Journ. Sci.* (1906), 1, 997.

IDEM. Problems in economic entomology in the Philippine Islands. *Philip. Journ. Sci.* (1906), 1, 1067.

IDEM. Biology of Philippine Culicidæ. *Philip. Journ. Sci., Sec. A* (1908), 3, 235.

IDEM. A mosquito which breeds in salt and fresh water. *Philip. Journ. Sci., Sec. B* (1908), 3, 335.

IDEM. Experiments in malarial transmission by means of Myzomyia ludlowii Theob. *Philip. Journ. Sci., Sec. B* (1908), 2, 513.

IDEM. Four new Culicidæ from the Philippine Islands. *Philip. Journ. Sci., Sec. A* (1910), 4, 545.

IDEM. Mosquitoes and other insects: medical survey of the town of Taytay. *Philip. Journ. Sci., Sec. B* (1909), 4, 233.

IDEM. The mosquito survey in and near San José. *Philip. Journ. Sci., Sec. B* (1914), 9, 163.

IDEM. A new Philippine malaria mosquito. *Philip. Journ. Sci., Sec. B* (1914), 9, 405.

* BANKS, N. A revision of the Ixodoidea or ticks of the United States. *Tech. Bull. U. S. Dept. Agr., Bur. Ent.* (1908), No. 15.

* IDEM. The Acarina or mites. A review of the group for the use of economic entomologists. *Rep. U. S. Dept. Agr., Off. Secy.* (1915), No. 108, 153, fig. 294.

BEZZI, M. Studies in Philippine Diptera, I. *Philip. Journ. Sci., Sec. D* (1913), 8, 305.

BISHOPP, F. C. The distribution of the Rocky Mountain spotted-fever tick. *Circular U. S. Dept. Agr., Bur. Ent.* (1911), No. 136.

BLANCHARD, R. Les Moustiques, histoire naturelle et medical (1905), 673 pp.

* BRAUN, MAX. The Animal Parasites of Man (1906), 351.

CHAGAS, CARLOS. Nova Tripanozomiaze humana. *Mem. do Inst. Osw. Cruz* (1909), 159, pl. 9.

CONRADI, A. F. Black-fly studies. *Bull. U. S. Dept. Agr., Bur. Ent.* (1905), No. 52, 100.

DE MEIJERE, J. C. H. Blutsaugende Micro-Dipteren. *Tijdschrift voor Ent.* (1909), 52, 191.

* DOANE, R. W. Insects and Disease. H. Holt & Co., New York (1910). (For general bibliography.)

FELT, E. P. Household and camp insects. *Bull. N. Y. State Mus.* (1917), No. 194.

* GIEBEL, C. G. Insecta Epizoa. Halle (1874).

* GIRAULT, A. A. The bedbug; literature, pathogenic relations, etc. *Psyche* (1906), 13, 42.

HAMILTON, J. The red bug. *Ent. News* (1896), 7, 2.

* HERRICK, G. W. Insects Injurious to the Household and Annoying to Man. Rural Science Series. New York (1914), XVII + 470 pp.

HOWARD, L. O. The principal household insects of the United States. *Bull. U. S. Dept. Agr., Bur. Ent.* (1896), No. 4.

IDEM. The insects to which the name "kissing-bug" became applied during the summer of 1899. *Bull. U. S. Dept. Agr., Bur. Ent.* (1900), No. 22, 24–30.

IDEM. Economic loss to the people of the United States through insects that carry disease. *Bull. U. S. Dept. Agr., Bur. Ent.* (1909), No. 78, 40.

KELLOGG, V. L. American Insects. American Nature Series, 2d ed., New York (1908), XIV + 694 pp.

LEFROY, M. A preliminary account of the biting flies of India. *Bull. Agr., Research Inst.* (1907), No. 7.

LUDLOW, C. S. Two Philippine mosquitoes. *Journ. N. Y. Ent. Soc.* (1902), 10, 127.

IDEM. Concerning some Philippine mosquitoes. *Canad. Ent.* (1904), 36, 69.

IDEM. Mosquito notes, No. 3. *Canad. Ent.* (1905), 37, 129.

IDEM. Mosquito notes, No. 5. *Canad. Ent.* (1906), 38, 367.

IDEM. Mosquito notes, No. 6. *Canad. Ent.* (1908), 40, 32, 50, 331.

IDEM. Mosquito comment. *Canad. Ent.* (1909), 41, 22.

IDEM. New Philippine mosquitoes. *Canad. Ent.* (1909), 41, 97.

MARLATT. The blood-sucking cone-nose. *Bull. U. S. Dept. Agr., Bur. Ent., n. s.* (1896), No. 4, 38.

MITZMAIN, M. B. The rôle of Stomoxys calcitrans in the transmission of Trypanosoma evansi. *Philip. Journ. Sci., Sec. B* (1912), 7, 475.

IDEM. The bionomics of Stomoxys calcitrans Linnæus; a preliminary account. *Philip. Journ. Sci., Sec. B* (1913), 8, 29.

IDEM. The mechanical transmission of surra by Tabanus striatus Fabricius. *Philip. Journ. Sci., Sec. B* (1913), 8, 223.

* MIYAJIMA, M., and OKUMURA, T. On the life cycle of the "akamushi." *Kitasato Arch. Exp. Med.* (1917), 1, 1. (With synonymy and bibliography.)

NEIVA, ARTHUR. Informações sobre a biolojia do Conorhinus megistus Burm. *Mem. do Inst. Osw. Cruz* (1910), 2, 206.

NUTTALL, G. H. F. On the rôle of insects, arachnids, and myriapods as carriers of disease. *Johns Hopkins Hosp. Rep.* (1899), 8, 14, 17, 49, 119, 133.

* OSBORN, H. Poisonous insects. Reference Handbook of Medical Science (1902), 5, 158–169.

IDEM. Insects affecting domestic animals. *Bull. U. S. Dept. Agr., Bur. Ent., n. s.* (1896), No. 5.

IDEM. Harvest mites; chiggers. *Bull., U. S. Dept. Agr., Bur. Ent., n. s.* (1896), No. 5, 251.

PRATT, F. C. Notes on "punkies." *Bull. U. S. Dept. Agr., Bur. Ent.* (1907), No. 64, Part III.

RILEY, C. V. Buffalo gnats. *Rep. U. S. Comm. Agr. for 1886* (1887), 492.

IDEM. Some insect pests of the household. *Insect Life* (1889–90), 2, 104.

SCHAMBERG, J. F. An epidemic of a peculiar and unfamiliar disease of the skin. *Phila. Med. Journ.* (1901).

SIMMONS, W. J. The metamorphoses of the dog-flea. *Am. Month. Micros. Journ.* (1888), 227.

THEOBALD, F. W. A Monograph of the Culicidæ of the World. British Museum (Natural History) (1901–1910), Vols. I–V, Volume of plates.

IDEM. Flies and ticks as agents in the distribution of disease. *Proc. Assn. Econ. Biol.* (1905), 1.

VERJBITSKI, D. T. The part played by insects in the epidemiology of plague. *Journ. Hyg.* (1908), 8, 162–208.

WALKER, E. L., and BARBER, M. A. Malaria in the Philippine Islands, I. Experiments in the transmission of malaria with Anopheles. *Philip. Journ. Sci., Sec. B* (1913), 9, 381.

WALLACE, A. R. The Malay Archipelago. New York and London (1869), 2, 250. (On Culicoides sp.)

WASHBURN, F. L. The irritating harvest mites or "jigger." *Rep. State Ent. Minn.* (1908), 12, 156.

WILLISTON, S. W. North American Diptera. James T. Hathaway, New Haven, 2d ed. (1908), 405 pp.

THE PROSOPIDÆ, OR OBTUSE-TONGUED BEES, OF THE PHILIPPINE ISLANDS

By T. D. A. COCKERELL

(*University of Colorado*)

The Prosopidæ, represented by the genus *Prosopis* Fabricius, are easily recognized among the Philippine bees by their small size, short emarginate tongue, and scanty development of hair on the body. The wings have a large stigma and only two submarginal cells. The only Philippine bees that can be confused with them are the species of *Allodape*, which are long-tongued. In *Allodape* the face marks are unlike those of *Prosopis*, the broad light mark down the middle of the face being especially characteristic. The *Prosopis philippinensis* of Ashmead is an *Allodape*.

The Philippine species of *Prosopis*, so far as known, may be separated thus:

Abdomen steel blue ..... worcesteri sp. nov.
Abdomen black ..... 1.
1. Clypeus entirely yellow in male; small slender species, with the tarsi and greater part of the tibiæ yellow; lateral face marks not going above level of antennæ..... taclobana Cockerell.
Clypeus entirely black in female; lateral face marks cuneiform, truncate above; tubercles broadly edged with white; stigma piceous; abdomen strongly shining; both recurrent nervures meeting transverse-cubitals. tagala Ashmead.
Clypeus black with a light patch or spot..... 2.
2. Lateral face marks cuneiform, not extending along orbital margins above level of antennæ..... 3.
Lateral face marks extending above level of antennæ..... 4.
3. Mesothorax coarsely punctured, shining between the punctures. cuneifera sp. nov.
Mesothorax entirely dull and very finely and densely punctured; scutellum with large punctures..... opacissima sp. nov.
4. Scape with a light mark in front; light area on clypeus triangular, pointed above ..... 5.
Scape entirely black; light area on clypeus not pointed above..... 6.
5. Hind tibiæ entirely black in male..... palavanica Cockerell.
Hind tibiæ broadly yellow at base in male..... mindanensis Cockerell.
6. Clypeal mark shaped like a tall hat; upward extension of lateral face marks cuneiform, not extending far above antennæ. benguetensis sp. nov.
Clypeal mark a spot near lower margin; upward extension of lateral face marks narrow..... 7.

7. Mesothorax finely punctured ..... contradicta sp. nov.
Mesothorax coarsely punctured; female with face broad, area of clypeus above yellow mark about as broad as long; male with face narrow, area of clypeus above yellow mark much longer than broad.
luzonica Cockerell.

Prosopis worcesteri sp. nov.

Male (*type*).—Length, nearly 6 millimeters; dark blue, the cheeks and sides of thorax green; mandibles black, reddish apically; labrum black; clypeus white, with the lateral and inferior margins black; white lateral face marks filling space between clypeus and eye, and extending nearly halfway up front, ending obtusely but narrowly; scape black with a reddish spot at extreme base; flagellum short for a male, ferruginous beneath; mesothorax finely and closely punctured; tubercles with a pale spot, but prothorax otherwise dark; base of metathorax shining, area not distinctly defined; tegulæ black, wings dusky, stigma piceous; recurrent nervures joining second submarginal cell about equally distant from base and apex; basitarsi white or whitish except apically; hind tibiæ white at base.

Female.—Face dark green, without light markings; tubercles without light spot; hind tibiæ white at base, but their basitarsi entirely dark.

LUZON, Laguna, Los Baños, male (*Baker*, type); Mount Maquiling, females (*Baker*). Allied to *P. jacobsoni* Friese, from Java, but distinguished by the longer lateral face marks and dark clypeal margin. I have ventured to associate this pretty little species with the name of one who will be always remembered for his varied labors in the Philippine Islands.

Prosopis taclobana Cockerell.

Prosopis taclobana COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 16, 2.

LEYTE, Tacloban (from *Baker*).

Prosopis tagala Ashmead.

Prosopis tagala ASHMEAD, Proc. U. S. Nat. Mus. (1905), 28, 959.

LUZON, Manila (*C. S. Banks*). I have examined Ashmead's type.

Prosopis cuneifera sp. nov.

Female.—Length, 6 millimeters or over (abdomen of type strongly retracted); very robust, black; light marks of face consisting of cuneiform lateral marks, obliquely truncate above at level of antennæ, and a broad median band (not twice as long as broad) on clypeus, not extending above the middle third;

antennæ black; mesothorax and scutellum very coarsely punctured, scutellum and disk of mesothorax shining between the punctures; area of metathorax triangular, transversely plicate basally; tubercles with a large yellow spot, and a very widely interrupted yellow marginal band on prothorax; tegulæ piceous, with a yellow spot; wings rather dusky, stigma piceous, first recurrent nervure joining second submarginal cell a short distance from base; legs black, anterior tibiæ with a broad yellow stripe on more than basal half, middle tibiæ with a light spot at extreme base; hind tibiæ broadly light at base; abdomen broad, polished, without evident punctures.

LUZON, Mount Banahao (*Baker*). Somewhat related to *P. feai* Vachal, from Burma.

Prosopis opacissima sp. nov.

Female.—Length, 5.5 to 6 millimeters; black, with the mesothorax dull and excessively densely punctured, the scutellum with much larger and more widely separated punctures; mandibles black, red at apex; orbits strongly converging below; yellow face marks consisting of cuneiform lateral marks, truncate above at level of antennæ, and a broad band on clypeus, not reaching upper margin, its length at least twice its breadth, and its upper end rounded; scape black, flagellum very obscurely brown beneath; thick upper border of prothorax interrupted in middle, tubercles and spot on tegulæ yellow; base of metathorax dull and rugose; wings hyaline, stigma brown; first recurrent nervure meeting first transverse cubital; basitarsi, basal two-thirds of anterior tibiæ in front, middle tibiæ at base, and nearly basal half of hind tibiæ yellow; abdomen moderately shining, with extremely fine punctures.

MINDANAO, Davao (from *Baker*, type locality). LUZON, Laguna, Mount Maquiling (from *Baker*). Related to *P. scutula* Vachal, from Burma.

Prosopis palavanica Cockerell.

Prosopis palavanica COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 16, 1.

PALAWAN, Puerto Princesa (from *Baker*).

Prosopis mindanensis Cockerell.

Prosopis mindanensis COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 16, 486.

MINDANAO, Dapitan (from *Baker*).

Prosopis benguetensis sp. nov.

Male.—Length, about 6.5 millimeters; black, with rather slen-

der abdomen; labrum and mandibles black; pale lemon yellow lateral and clypeal marks, the former extending a short distance above level of antennæ, acutely angulate above and below, the upper inner side shorter than the lower inner; clypeal mark a very broad band, truncate submarginate above, and with a small projection at each side of base; scape black, rather robust; flagellum long, coffee brown beneath; head very finely punctured; mesothorax finely and closely punctured, punctures of scutellum larger, but dense; base of metathorax polished and shining; end of tubercles and two marks on upper margin of prothorax yellow; ventral surface of thorax with white hair; tegulæ piceous, with no light spot; wings somewhat dusky, the apical region decidedly brown; stigma dark reddish brown; first recurrent nervure meeting first transverse cubital, but second recurrent going beyond end of second submarginal cell; anterior tibiæ yellow in front, but legs otherwise dark, except that hind basitarsi are a little pallid at base; abdomen shining, with very fine punctures on second and following segments; lateral hind margins of segments with poorly developed white hair bands.

LUZON, Benguet, Baguio (*Baker*). Easily distinguished from *Prosopis contradicta* and *P. mindanensis* by the shining base of metathorax.

Prosopis contradicta sp. nov.

Male.—Length, about 6 millimeters; black, with yellow markings as follows: Small mark above apical margin of clypeus, narrow lateral face marks (shining on inner side) narrowly continued up orbital margin some distance above antennæ, rather narrowly interrupted band on prothorax, spots on tubercles and tegulæ, and anterior tibiæ in front. Scape short; flagellum long, dark coffee brown beneath; sides of front with rather large punctures; mesothorax and scutellum distinctly shining, finely but very distinctly punctured; area of metathorax elongated, dull and rough, but the oblique lateral margins shining; abdomen reddish black; segments (including first) with very minute sparse punctures.

NEGROS, Cuernos Mountains (from *Baker*). Somewhat related to *P. mustela* Vachal, from Burma.

Prosopis luzonica Cockerell.

Prosopis luzonica COCKERELL, Ann. & Mag. Nat. Hist. (1914), VIII, 14, 364 (♀); (1915), 16, 486 (♂).

LUZON, Mount Maquiling and Mount Banahao (*Baker*).

THE PHILIPPINE BEES OF THE FAMILIES ANTHOPHORIDÆ AND MELECTIDÆ

By T. D. A. COCKERELL
(*University of Colorado*)

The two families now discussed include the most highly ornamented Philippine bees, remarkable for their blue or green markings, due to appressed scalelike hairs. They are long-tongued; the Anthophoridæ make nests, in which the Melectidæ are parasitic. The latter are represented by the genus *Crocisa,* which is easily known by the expanded emarginate scutellum, with the margin W-like or ⌐^¬-like, according to the species. The species of *Anthophora* are swift and powerful fliers.

Genus ANTHOPHORA Fabricius

Abdomen with narrow white hair bands; a large robust species. luzonica Cockerell.
Abdomen with lilac or purple bands..... whiteheadi Cockerell.
Abdomen with shining green or bluish green bands .... korotonensis Cockerell.

Anthophora luzonica Cockerell.

Anthophora luzonica COCKERELL, Ann. & Mag. Nat. Hist. (1914), VIII, 14, 12.

LUZON, Laguna, Mount Maquiling (*Baker*).

Anthophora whiteheadi Cockerell.

Anthophora zonata whiteheadi COCKERELL, Ann. & Mag. Nat. Hist. (1910), VIII, 5, 412; Proc. U. S. Nat. Mus. (1911), 40, 259.

LUZON, Cagayan, Cape Engaño (*Whitehead*). It is probably this insect that has been erroneously listed from the Philippines as *A. cingulata* Fabricius.

Anthophora korotonensis Cockerell.

Anthophora korotonensis COCKERELL, Ann. & Mag. Nat. Hist. (May, 1911), VIII, 7, 491.

Anthophora zonata stantoni COCKERELL, Entomologist (July, 1911), 44, 233; Ann. & Mag. Nat. Hist. (1915), VIII, 16, 4.

This is the species reported from the Philippine Islands as *A. zonata* Linnæus. I described it as *A. korotonensis* from a single male taken at Koroton, Formosa. The name *stantoni* was based on a female from Manila. A series of males from the Philippine Islands shows that both names refer to a single species. The females vary in the color of the bands on the abdomen, as follows:

Variety *a*, (*stantoni* proper), first two bands green, second two blue. Manila and Los Baños.
Variety *b*, first band emerald green, the other three pearly blue with a greenish tint. Los Baños.
Variety *c*, all the bands alike, extremely brilliant blue-green. Los Baños.
Variety *d*, bands very pale pearly green. Davao.

LUZON, Manila (*W. A. Stanton*): Laguna, Los Baños and Mount Maquiling (*Baker*): Benguet, Baguio (*Baker*). MINDANAO, Davao (*Valdez*), Dapitan (*Valdez*).

Genus CROCISA Jurine

The records of *C. emarginata* Lepeletier, *C. nitidula* Fabricius, and *C. lamprosoma* Boisduval from the Philippines are undoubtedly erroneous. The following four species are known to occur:

Abdominal bands brilliant blue ..... 1.
Abdominal bands pallid blue or grayish ..... 2.
1. Abdominal bands shining, no inclosed black area on first segment, but a transverse posterior incision ..... cælestina sp. nov.
Abdominal bands shining, that on first segment interrupted by a longitudinal band in middle ..... crucifera sp. nov.
Abdominal bands very bright blue but not shining, first segment with a large black area surrounded by blue ..... luzonensis Cockerell.
2. [First abdominal segment with a very broad continuous basal hair band; abdominal bands gray with some lilac scales; wings very dark (Celebes) ..... kalidupana sp. nov.]
First abdominal segment with about the middle third dark; abdominal bands pale blue; wings only moderately dark ..... irisana Cockerell.

Crocisa luzonensis Cockerell.

Crocisa luzonensis COCKERELL, Ann. & Mag. Nat. Hist. (1910), VIII, 5, 419.

LUZON, Benguet, Irisan (collector unknown): Nueva Vizcaya, Imugan (*Baker*).

Crocisa irisana Cockerell.

Crocisa irisana COCKERELL, Entomologist (Aug. 1910), 219.

LUZON, Benguet, Irisan (collector unknown). Type in British Museum.

Crocisa cælestina sp. nov.

Female.—Length, about 11 millimeters; very robust, black, with the tegument of the abdomen more or less purplish; blue markings exceedingly brilliant and shining, as follows: Upper half of face, supraclypeal region (which is very strongly keeled), sides of front broadly, small patches next to ocelli, band on cheeks, very large transverse patch on pleura, small spot on lowest part of pleura, transverse spots partly on mesothorax

and partly on prothorax, longitudinal band on anterior part of mesothorax, large spot on each side of disk, line over tegulæ, spot in front of each axilla, very broad band across first abdominal segment (the posterior margin broadly incised in middle, the lateral corners of the incised area pointed), broad bands (narrowly interrupted in middle) on second to fifth segments; spot on hind coxæ, outer side of middle and anterior tibiæ, but only basal half of hind tibiæ, and a few blue scales on anterior tarsi. Middle and hind tarsi and the W-like scutellum without blue; wings dark fuliginous; clypeus finely and closely punctured; flagellum obscurely reddish beneath.

LUZON, Laguna, Los Baños (*Baker*). A beautiful species, distinguished from *C. rostrata* Friese by the immaculate scutellum and dark basitarsi. It is very closely related to *C. nitidula* Fabricius from Amboina, but is larger, with somewhat different scutellum, and the markings clear cobalt blue, not greenish blue. The name *nitidula* has been applied to various forms, but I have seen a specimen from Amboina, the original locality.[1] It is possible that the Philippine and Amboina insects may be found to represent only races of one species, but they are more likely to be distinct, without intergrading forms.

The following species from Celebes is described, as it was sent by Professor Baker with the Philippine collection:

Crocisa kalidupana sp. nov.

Male.—Length, about 9 millimeters; black, the tegument of abdomen slightly purplish; light markings pale gray, with lilac scales sparsely intermixed on prothorax, pleura, sides of abdomen, and legs; light patches and spots as follows: Face and sides of front, band on cheeks, interrupted band on prothorax (slightly invading mesothorax), large rounded patch on pleura, five spots on mesothorax (the anterior median one short and those before axillæ small), very broad band on first abdominal segments, very broadly incised in middle, the corners of the incision pointed, broadly interrupted bands on the other segment, outer side of anterior tibiæ, and large spots on basal half of middle and hind tibiæ. Scutellum (which is ⌒⌒⌒-like) and tarsi without light marks; wings dark fuliginous; anterior femora very small, reddish; hind femora with a sharp thorn-like tooth beneath.

CELEBES, Kalidupa (*H. Kühn*). Related to *C. quartinæ* Gribodo, but easily separated by the color of the markings. The

[1] See *Bull. Am. Mus. Nat. Hist.* (1907), 233, where for "scutellum without dark marks" read "without *light* marks."

type of marking on the first abdominal segment is the same as that in *C. cælestina*, but in *C. cæruleifrons* Kirby the basal band is interrupted in the middle, though the posterior incised or excavated area is of the same character.

Crocisa crucifera sp. nov.

Male and female.—This is the species that Friese determined for Professor Baker as *C. quartinæ* Gribodo (type locality, Celebes), but he included in *quartinæ* a variety of species, even the shining blue-spotted one of Australia. *Crocisa crucifera* differs from the description of *C. quartinæ* by the two conspicuous blue spots on the scutellum; it also has the scutellum W-like, though the incision is very wide and relatively shallow. The first abdominal segment is blue, except the hind margin and a longitudinal median band, and the longitudinal band extends down the other segments, producing a black cross on a blue ground. The male has the hind femora toothed beneath.

LUZON, Laguna, Los Baños (*Baker 306*).

The somewhat related Australian form, which has also passed as *quartinæ*, requires a name:

Crocisa omissa sp. nov.

Crocisa quartinæ COCKERELL (not Gribodo), Proc. Linn. Soc. N. S. W., 1912 (1913), 595.

Crocisa cæruleifrons COCKERELL (not Kirby), Entomological News (1907), 46.

The scutellum is ⌒-like and without blue spots; the pattern of the first abdominal segment is similar to that of *C. cæruleifrons*, except that the incision is broader.

I have seen the type of *cæruleifrons* Kirby; it is certainly distinct. The type of *C. omissa* is from Mackay, Queensland (*Turner 302*), the species extends south to New South Wales.

The following new species of *Crocisa* have been lately obtained by Prof. C. F. Baker in the Malay Peninsula:

Crocisa callura sp. nov.

Female.—Length, 15 millimeters; very robust, black, with turquoise-blue markings, not shining; wings very dark fuliginous, even the usual pale spots dusky; scutellum without blue spots, its margin ⌒-like. Allied to *C. decora* Smith, but larger, and with the following special characters: Median blue mark on mesothorax a band extending over halfway from anterior margin toward posterior end; spots on each side of disk large, oval; posterior spots large; axillæ with small spots; scutellum longitudinally grooved and well punctured; tubercles

with black fringe; upper end of mesopleura covered with pale blue hair, and a blue spot on lower part, the interval black; white hair projecting beneath scutellar notch; anterior and middle tibiæ blue on outer side, hind tibiæ with only basal half blue; all the basitarsi with blue hair on outer side; first abdominal segment with basal band having a linear interruption, and the transverse black discal area with its basal edge straight, its lateral corners pointed, and the apical blue band widely interrupted; the other abdominal segments have rather widely interrupted bands; apical segment without blue.

PENANG ISLAND (*Baker 9077*). *Crocisa ridleyi* Cockerell, from Penang, is smaller, with W-like scutellum, anterior margin of pleura entirely covered with light hair, markings much paler, and other differences.

Crocisa reducta sp. nov.

Female.—Length, about 11 millimeters; black, with turquoise-blue markings, not shining; anterior wings fuliginous, with the usual pale spots and areas well marked; scutellum without blue spots, its margin ⌐¬-like. Allied to *C. callura*, but smaller, and differing thus: Third antennal joint shorter than fourth (longer than fourth in *callura*); median mark on mesothorax short, not longer than the transverse diameter of anterior marginal marks, not closely approaching anterior margin; spots on each side of disk small; spots on axillæ larger; scutellum polished and punctured, the punctures more or less in transverse rows; first abdominal segment with basal band continuous, but apical band extremely widely interrupted, and the lateral lobes of the black area very broadly obliquely truncate at end, the upper (basal) margin of the black area also concave; pygidial plate broader at end.

SINGAPORE (*Baker 9076*). A specimen of *C. decora* Smith, also from Singapore, is very similar, but has much larger spots on each side of disk of mesothorax, and the scutellum with very minute punctures, those of *reducta* being strong and very distinct.

THE ABSENCE OF BOTH HIND LEGS BELOW THE FEMUR IN A FULL-TERM PIG

By MARCIANO CARREON

(From the Deparment of Anatomy, University of the Philippines)

ONE PLATE

Recently I had the opportunity to observe a pig in the act of parturition. The third pig that was born attracted my attention, in as much as it could not stand like the first two. When all were born—seven in the litter—I picked up the third one and found its two hind legs missing. The pig appeared normal in every other way, breathing regularly, but it was somewhat weak and exhausted. The specimen was immediately taken to the laboratory, where it died two hours later. Efforts were made to sustain life, but these were all in vain.

All of the pigs in the litter were measured. The average crown–rump length—that is, the distance from the vertex of the head to the buttocks—was 160 millimeters. The pig without the hind legs was a female with a crown–rump length of 151 millimeters. Some of the normally developed pigs were of about the same length as the specimen. When compared with some of the smaller members of the litter, it was quite apparent that this pig was not underdeveloped.

The external features of the pig were carefully studied, various measurements were taken, and a careful dissection was made to determine if any other abnormalities were present. The length of the femur was 31 millimeters, which was 5 millimeters longer than the humerus. The length of the femur in the specimen and in the normal pigs was found to be almost identical, so it was apparent that the femur was normally developed. Attached to the skin overlying the distal ends of the femur were two minute appendages forming a whorllike arrangement. Each mass was less than a millimeter in its dimensions, and was composed of dried tissue, apparently the remains of the atrophied portion of the extremities, growth evidently having ceased very early in the development of the limb buds.

A dissection of the right hind thigh was carried out to determine the arrangement of muscles and their attachments (Plate

I, fig. 3). The muscles of the thigh were all normally arranged, but the muscles having their insertion at the proximal end of the tibia and the fibula were attached to the end of the femur by fibrous connective tissue. At the distal end, and lying slightly anteriorly and laterally, a single cartilaginous mass was found—apparently the patella. The patella was attached to the end of the femur by fibrous connective-tissue bands.

On careful examination I also discovered that the pig had a cleft palate. This extended from the posterior part of the alveolar process throughout the entire soft and hard palate (see Plate I, fig. 2). The length of the cleft was 27 millimeters; its width was 3 millimeters anteriorly and 7.5 millimeters posteriorly. The nasal septum and various parts of the roof of the nasal cavity can be easily made out. The tongue appears normal in size, but on the median line is a ridge which fits into the cleft palate. This ridge serves as a palate for inspiration and expiration.

In this interesting specimen two abnormalities were found; namely, the missing legs and the cleft palate. It is reasonable to assume that the underlying cause producing the pathological conditions was identical for both anomalies. Both show an interrupted growth very early in the development of the pig. What the influence was that inhibited the growth of the legs and the palate is not definitely known, though everything points toward a physicochemical interference with growth. Mall[1] discusses this question in great detail and in part says:

> It would have been quite simple to conclude that the poison produced by an inflamed uterus should be viewed as the sole cause, but when it is recalled that the pathological ova occur far more commonly in tubal than in uterine pregnancy, such a theory becomes untenable. Moreover, monsters are frequently observed in swine and other animals without any indication of an inflammatory environment. For this reason I have sought the primary factor in a condition buried in the non-committal term faulty implantation. It would seem to be apparent that lesions occurring in the chorion as the result of faulty implantation, can and must be reflected in the embryo.

He further states:

> It is perfectly clear that monsters are not due to germinal and hereditary causes, but are produced from normal embryos by influences which are to be sought in their environment. Consequently, if these influences are carried to the embryo by means of fluids which reach it either before or after the circulation has become established, it would not be very far amiss to attribute these conditions to alterations in the nutrition of the embryo.

[1] On the frequency of localized anomalies in human embryos and infants at birth, *Am. Journ. Anat.* (1917), 22, 69.

In as much as all of the other pigs in the litter were normally developed, we can at once exclude the probability that uterine inflammation may have interfered with the normal process of development. It seems probable on the other hand that a faulty implantation might produce a pathological condition such as we found in this specimen. The cause in this case may have been primarily a mechanical one that was reflected on the embryo, thus producing the malformation. The presence of the appendages attached to the skin overlying the distal end of the femur seems to indicate that the extremities were more developed at some previous time. However, when the factor that produced the malformation appeared, the further development of the palate and the hind legs ceased.

In making this report I am indebted to Prof. Edward S. Ruth and the members of the anatomical staff for valuable criticisms and suggestions; for all of which I wish to express my appreciation.

ILLUSTRATION

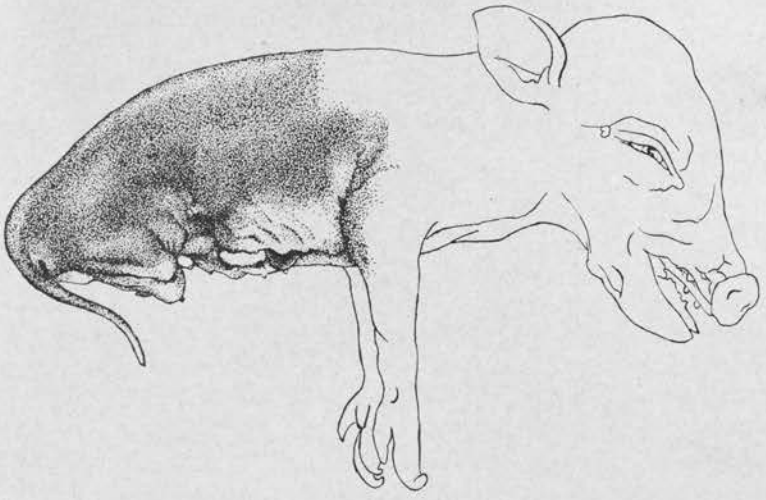
[Drawings by Vicente Santos.]

PLATE I

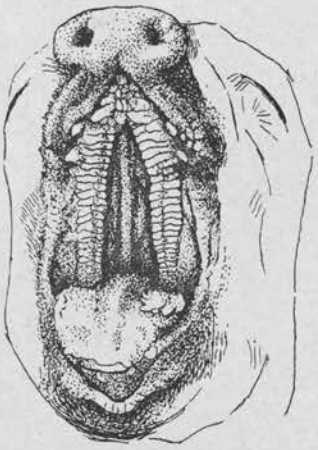
FIG. 1. An abnormal pig, showing the right lateral side with the hind limbs missing. On the distal end of the femur may be seen the small appendage that is mentioned in the text. Two-thirds actual size.

2. Front view of the head of the pig specimen, showing the cleft palate with the ridge on the tongue. Actual size.

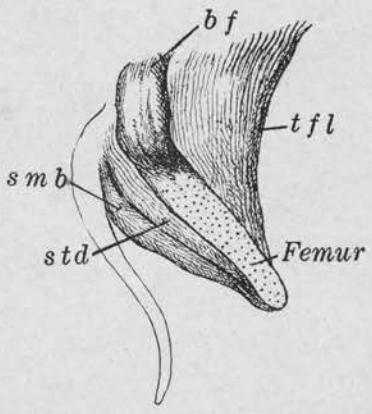
3. Dissection of the muscles of the thigh of the pig specimen. Actual size. *bf*, biceps femoris; *smb*, semimembranosus; *std*, semitendinosus; *tfl*, tensor facia lata.



1



2



3

PLATE I. AN ABNORMAL FULL-TERM PIG.

ON THE INGESTION OF ERYTHROCYTES BY PENTATRICHOMONAS SP., FOUND IN A CASE OF DYSENTERY

By FRANK G. HAUGHWOUT[1] and WALFRIDO DE LEON[2]

(From the Department of Parasitology, College of Medicine and Surgery, University of the Philippines)

ONE PLATE

On March 9, 1919, there was admitted to the pediatrics ward in the Philippine General Hospital, on the service of Dr. José Albert, "S. de G.," Filipina, female, 6 years old, for treatment of a condition described as acute dysentery.

The child had been passing frequent bloody and mucoid bowel movements for seven days prior to admission, the stools averaging about twenty in number in the twenty-four hours. Each movement was accompanied by painful tenesmus. Four days after the onset of the disease the stools became black and gave off a pronounced fishy odor.

On admission to the hospital the child had slight fever. The pulse was of fair volume. She was weak and looked sick, and her eyes were slightly sunken. At the time, however, her lungs were clear, and the heart was in good condition; in short, the general condition of the patient was good. A day or two later she developed a mild bronchopneumonia. The parents stated that the child had suffered from dysentery when she was 3 years old. The attack had lasted three days, during which time she had passed numerous bloody and mucoid stools, and ceased following the administration of a purgative. The patient had also suffered from epileptiform attacks from time to time. There was no other intestinal infection of a similar nature in the house, but the parents said the child sometimes drank the city water, sometimes artesian-well water, but very frequently water that was literally filthy.

Examination of the child's stool in the hospital laboratory disclosed the presence of numerous flagellates and moderately heavy infections with *Ascaris lumbricoides* and *Trichuris trichiura*. No entamœbæ were found. The stool contained mucus,

[1] Professor of protozoölogy and chief, department of parasitology.
[2] Instructor, department of pathology and bacteriology.

leucocytes of various types, pus, and enormous numbers of erythrocytes. Bacteriological examination for *Bacillus dysenteriæ* was negative, but it should be noted that the bacteriologist did not receive a fresh stool.

During the stay of the patient in the hospital the temperature was intermittent in type. There was a daily rise toward evening, and a fall to the lowest point in the morning. The variations in temperature ranged between 36.5° C., and 38.25° C.

The pulse varied between 100 and 125, and the respirations, between 30 and 40 to the minute. The bowel movements recorded were as follows: March 9, four; March 10, four; March 11, seven; March 12, seven.

The treatment given consisted of intramuscular injections of antidysenteric serum, purgatives, and stimulants.

The patient failed to improve, but on the contrary grew steadily worse, and with the development of the pneumonic symptoms her condition became very serious. Notwithstanding this the parents, who were of the poorer class of Filipinos, insisted on taking the patient home. Against the strongly expressed advice of the physicians in charge of the case they took the girl home on the morning of March 13, at which time she was virtually in a dying condition. It was learned through the social service department of the hospital that the child died a day or two later. Whether she succumbed to pneumonia or dysentery we cannot say.

A specimen of the stool was sent to the department of pathology of the hospital on March 12. There it was examined by one of us (W. de L.) and found to contain swarms of flagellates of the trichomonad group.[3] The stool was liquid and contained considerable blood. A slight amount of mucus was found sticking to the bottom of the container. This is the type of stool quite characteristic of heavy flagellate infections we have seen, and has led us to suspect the presence of *Trichomonas* on occasions other than this. Microscopically, however, considerable detritus was found, such as leucocytes, and epithelial cells in various stages of disintegration which, of course, suggested the possibility of the presence of bacillary dysentery. We believe, nevertheless, that such evidence of inflammatory reaction oc-

[3] We apply the term trichomonad as a common name for polymastigote flagellates having an undulating membrane, axostyle, and parabasal as *Trichomonas*, *Tetratrichomonas* and *Pentatrichomonas*. We employ it in the same sense as the properly employed term ameba as used by Schaeffer, but not as unhappily used as a generic name by some of the medical journals.

curring in cases of protozoal infection may, in some instances, be due to secondary invasion of the tissue by bacteria other than the dysentery bacilli.

It was quickly seen by the examiner that the flagellates in many instances contained erythrocytes. The finding was immediately communicated to the senior author and the stool specimen sent to the laboratory of parasitology.

The observation was quickly confirmed by the senior author who, in the course of the examination of several preparations, noted 103 flagellates that had ingested one or more erythrocytes, some of which presented evidence of having undergone partial digestion—an appearance frequently seen in *Entamœba histolytica* containing ingested erythrocytes. More than this, the actual process of ingestion was observed in one individual found in the act of taking in a corpuscle and whose progress was followed under the microscope for nearly an hour. During that time the parasite ingested no less than three corpuscles. The individual that went through this performance was actively swimming about in the fæcal débris and when first seen had applied its anterior extremity to an erythrocyte that was being drawn in through the cytostome, as shown in Plate I, fig. 3. The operation of ingestion consumed about fifteen seconds, during which time the organism maintained its active movements. The act was one of literal deglutition. The corpuscle entered the cytoplasm as if drawn in by suction, though it was probably accomplished by the action of myonemes or similar structures entering into the formation of the cytopharynx. Its progress may be traced by inspection of Plate I, figs. 3 to 8, which show the deformation of the corpuscle as it passed through the narrow orifice of the cytostome. In time, the corpuscle came to lie free in the cytoplasm toward the posterior end of the animal, where it produced a slight bulge in the body. The formation of a digestive vacuole around the erythrocyte was not observed; nor could any vacuoles of that nature be discovered in any of the other individuals seen that had taken in corpuscles. The erythrocytes simply seemed to lie free in the cytoplasm where they were carried about in the cellular cyclosis. No individual was seen that contained bacteria, so far as could be made out, which leads us to the belief that this particular species is not a bacteria eater, but possibly derives its nourishment from erythrocytes and other tissue elements. This, of course, presupposes an adaptation to parasitism of a more complete type than we have evidence of in the other intestinal flagellates infesting man.

The other two corpuscles that were taken in by this individual were ingested in substantially the same manner, but the parasite was lost from the field in the sudden shifting of fluid due to evaporation and could not again be found. In no instance did we observe the expulsion of a corpuscle that had been ingested.

The presence of the projecting axostyle and the marginal undulating membrane placed the parasite in the trichomonad group, but it was not until specimens were stained that the five anterior flagella were discovered that enabled us to place the organism definitely in the genus *Pentatrichomonas*. Unfortunately, only two slides were prepared from this stool for staining, for it was assumed that the case would remain in the hospital and that an abundance of material could be procured for study. It was felt that the case was one of unusual interest, and efforts would have been made to secure an autopsy had the patient died in the hospital.

At the time we made this observation, we believed that the ingestion of erythrocytes by an intestinal flagellate had not been reported previously; but subsequently we were able to obtain Chatterjee's original paper on *Pentatrichomonas*(3) in which he says: "In several a full sized red corpuscle was found inside the body; no vacuole is seen." We have been unable to find any development of this observation in the literature accessible to us.

STUDY OF THE STAINED PREPARATIONS

The films were fixed in Bouin's picro-aceto-formol solution and stained by the alcoholic iron-hæmatein method of Dobell. The slides were carefully searched with the aid of the mechanical stage, and we failed to find *Entamœba histolytica* or any other protozoön in either the trophozoite or encysted stage. So far as concerns the parasite in question the results were rather disappointing, as is apt to be the case with preparations of the intestinal flagellates. These parasites show a tendency to conceal themselves in the thicker parts of the film, and they only swim out into the open after the lapse of time. Relatively few were found. Fig. 1 shows an individual, found near the margin of one film, that had unfortunately undergone some distortion through almost complete drying before the preparation was fixed. It was drawn because it contained a deeply stained disklike body that was, in all probability, an erythrocyte. Fig. 2 shows a fairly perfect individual, in which most of the parts are demonstrated. In no case did we succeed in demonstrating the mouth parts. Special methods such as are used in the demonstration of the neuromotor apparatus of ciliates and flagellates, such as

Mallory's connective-tissue stain, would probably yield better results. Indeed, we are inclined to believe, from the exceedingly coördinated nature of the process of deglutition and the accompanying phenomena, that the animal may be found to possess a well-developed neuromotor apparatus, such as has been described by Sharp(12) and Boeck(2) in the case of certain ciliated and flagellated endoparasitic protozoa.

A fairly complete picture of the organism was secured from a study of the individual shown in fig. 2. The structures did not all stand out with the sharpness shown in the figure, but we are quite convinced of the presence of the parabasal body and the undulating membrane, neither of which could be seen with any distinctness in the individual shown in fig. 1. A puzzling feature shown in fig. 2 is the row of chromatinic granules of graduated size, that appear to lie free in the cytoplasm between the parabasal and the axostyle. These were rather deeply staining, and we believed at first inspection that they marked the line of the axostyle and represented the axostylar chromatinic granules seen so frequently in the trichomonads. But later, we discovered the axostyle lying in the position shown in the figure and convinced ourselves of its identity. Therefore, the question arises as to the nature of these large, prominent granules; for their extreme regularity in position and their size gradation belie the supposition that they are erythrocytes in various stages of digestion.

Ordinarily, the axostyle and the "axostylar chromidia" are demonstrated with some difficulty, after careful staining and extraction and under exceptionally good illumination. The axostyle in both stained individuals figured was quite clear and distinct; the granules shown in fig. 2 took the stain as intensely as the nucleus. The conformation in which they lay suggested an axostylar relation, and if the granules seen in the axostyles of other trichomonads are intra-axostylar, as many workers believe, the questions arise as to whether the granules shown in our preparation are identical with the axostylar granules of other species and, if they are, what they are doing free in the cytoplasm. The axostyle itself was perfectly clear throughout its length. Its posterior extremity had been drawn into the cytoplasm, and throughout its entire length it showed no trace of the presence of "axostylar chromidia." In fig. 2 it will be seen that the axostyle is apparently carried anteriorly to the point where its anterior extremity seems to underlie the nucleus. The nucleus was of the karyosome type with a fairly large karyosome, and more or less abundant peripheral chromatin lying

within a nuclear membrane. However, we do not consider that the material available to us in this case has been either sufficiently abundant or suitable for making the cytological study of the parasite that these remarks suggest. Now that we know of the presence of *Pentatrichomonas* in the Philippine Islands we shall watch for further infections with it, with a view to confirming these observations and working out some of the details.

A sufficient number of individuals was not forthcoming on our slides to enable us to make measurements that would justify us in giving the mean size of this species. Those we measured varied in length from 14 μ to 18 μ and in width from 10 μ to 13 μ. The anterior flagella measured from 8 μ to 10 μ, and were approximately of equal length.

This is the first time that *Pentatrichomonas* has been reported from the Philippine Islands, but as Chatterjee(4) has reported it as commonly occurring in India, we think it likely that when sought here it will be found to be of as frequent occurrence. Because of the lack of proper material for study we deem it unwise, for the present, to give specific designation to the form observed by us. Derrieu and Raynaud, who described a similar parasite from Algiers in 1914 under the name *Hexamastix ardindelteili*,(5) gave measurements of from 10 μ to 15 μ in length and from 9 μ to 13 μ in width. The flagella, they stated, varied in length from 10 μ to 17 μ. Chatterjee's *Pentatrichomonas bengalensis*, described by him in 1915, was said to vary in length from 8 μ to 10 μ, and in width from 5 μ to 6 μ, with a flagellar length of from 8 μ to 10 μ. The few measurements made by us seem to fall fairly well between the two, but Mesnil(11) has already suggested a duality of species between Derrieu and Raynaud's parasite (now included in the genus *Pentatrichomonas*) and Chatterjee's *Pentatrichomonas bengalensis*. Fantham has concurred in this. In view of this, we refrain from bestowing a specific name on this parasite until we have had the opportunity to check our observations on other cases and to make a more thorough study of the organism.

DISCUSSION

Notwithstanding the extreme limitations that were placed on our study of this single case, we regard the observation as an important one. We feel that it lends support to the contention of Chatterjee that *Pentatrichomonas* is pathogenic and may produce dysentery in the general acceptance of that term.

A few months ago one of us (F. G. H.) published a paper on the tissue-invasive powers of the flagellated and ciliated in-

testinal Protozoa(8) and, although certain of the views therein expressed by the author have been modified by him in the light of more recent publications—particularly those of Wenyon and O'Connor and other British protozoölogists—it seems apropos to quote the following paragraph from the paper (p. 255):

> Next in order appears to be the desirability of attempting to explain the conflicting opinions expressed by different authors regarding the pathogenicity of the intestinal flagellates. It has been shown that some workers regard these forms as harmless or capable, at the most, of giving rise to nothing worse than diarrhœa, while others frankly express the belief that they may produce dysentery—actual lesions of the bowel. Is it possible that we have here different strains of the same organism, some showing and others not showing tissue-invasive powers—a condition somewhat resembling the relation between *Entamœba histolytica* and *Entamœba coli?*

At least one other observer, Barlow,(1) has suggested that it "is not impossible" that there may be different strains, or even species, of *Trichomonas* and that some of them may at times be more or less pathogenic.

In connection with this particular case, these facts must be carried in mind in the attempt to interpret our observation: (1) The patient, according to the assertion of her relatives, had suffered from an attack of dysentery of short duration some three years previous to this attack. (2) On admission to the hospital she showed characteristic clinical symptoms of dysentery, the stools passed were of dysenteric character, not merely diarrhœal, and contained large numbers of *Pentatrichomonas.* (3) Careful search by three observers failed to detect the presence of *Entamœba histolytica;* the findings of three microscopists agreed in all other essential details. (4) The microscopic picture of the stool, though it was similar to that presented by many cases of flagellate infection we have seen, yet suggested the possibility of bacillary dysentery.

The fact that the bacteriological examination for *Bacillus dysenteriæ* was negative carries no weight with us, for our experience is that negative findings in such cases are worthless, especially if the stool has not reached the bacteriologist immediately after its passage. So, in short, we are left in doubt as to whether the dysenteric symptoms were due to a protozoal, a bacterial, or a mixed infection. This is aside from the statement of Chatterjee that he recognizes flagellate dysentery as a distinct entity and incriminates *Pentatrichomonas* as one genus that may be an etiologic factor.

To our minds the most important feature lies in the observa-

tion of a trichomonad that ingests red blood corpuscles. Only second in importance to this is the question as to whether they are digested by the parasite or are only fortuitously taken up to be later expelled like non-nutritious matter or unaccustomed food taken in by many of the free-living species of protozoa. The faculty of food selection is a striking feature of the life activities of many protozoa, both free-living and parasitic. Calkins, speaking in a rather happy vein of certain predatory forms says that they "seem to select their food with all the care of a gourmand." With many forms "all is grist that comes to the mill" and then the process of selection may take place within the cytopharynx or possibly within the cytoplasm, the non-nutritious matter or the nutritious matter to which the animal is not adapted being rejected and cast back into the environment. Many species are known to thrive best on some particular species of bacteria to the exclusion of others; some will prey upon smaller protozoa of one species alone to the exclusion of all others, as in the case of *Didinium nasutum* which derives its sole nourishment from *Paramœcium caudatum*, and the same principle probably applies to a certain extent in the parasitic species, and is expressed to a degree in the predilection of certain species for certain organs or tissues where they find the food to which they have become adapted. Others may nourish themselves by one method under certain physical conditions, and by another when these conditions change. From this viewpoint, therefore, the problem becomes one of the bionomics of this particular trichomonad; and, having in mind the not infrequent occurrence of mixed bacillary and protozoal dysentery, we are inclined to cast the dysenteric symptoms out of this discussion until we can make further observations.

Erythrocytes may be said to constitute a fairly specialized diet, one that in the natural order of events might be expected to be indulged in only by an organism that is, to a certain extent, adapted to life in the tissues. The lumen-dwelling intestinal parasites are, for the most part, vegetarians. Those which can be shown to make a meal from blood corpuscles and to derive nourishment therefrom have become carnivores and immediately fall under suspicion of being likely to cause destruction of tissues. The case has been pretty well proved against *Entamœba histolytica* almost in this count alone to the extent that the presence of erythrocytes in the cytoplasm is of great diagnostic significance and now the burden of suspicion falls heavily on *Pentatrichomonas*.

In the material we were able to study we saw no individual in which we could detect bacteria such as one may find in the general run of lumen-dwelling forms. If we had encountered merely one or two individuals containing erythrocytes, we should have been inclined to place less weight on the observation, because trichomonads will frequently take in rather large bodies. (Kofoid and Swezy(9) figure *Trichomonas prowazeki* from the gut of *Diemyctylus torosus* with an engulfed "Blastocystis enterocola" fully half the size of its own body.) But here the senior author counted 103 individuals containing erythrocytes and observed many more, while the junior author likewise saw a large number. There was every apparent evidence that the ingestion of the corpuscles was not fortuitous, but was "purposeful" to the extent that the parasites literally seemed to "go after" the corpuscles; and, furthermore, the variation in size of the corpuscles contained in the bodies of the parasites suggested, on the analogy of *Entamœba histolytica*, that they were being digested and assimilated. It should be noted, further, that the cytoplasm of the organisms bore a distinct greenish tint such as is seen very frequently in *Entamœba histolytica* and is thought to be due to the breaking down of hæmoglobin. To be sure, this greenish tint is occasionally seen in *Entamœba coli*, according to some authors.

This seems to us to open a new line of attack on the general problem of the pathogenicity of the trichomonad flagellates found in the intestine of man. This group comprises three genera: *Trichomonas* (sensu stricto), with three anterior flagella; *Tetratrichomonas*, with four anterior flagella; and *Pentatrichomonas*, with five anterior flagella. All are equipped with an axostyle and an undulating membrane bearing a marginal flagellum which is continued beyond the posterior end of the body as a free lash.[5]

On the basis of our present knowledge, *Trichomonas* and *Tetratrichomonas* seem to be lumen-dwelling forms subsisting solely on bacterial life. But now *Pentatrichomonas* appears as a form adapted to the rather specialized diet of erythrocytes and, so far as we can see in this instance, gives no evidence of being

[5] As the proof on this paper is being read we have discovered a trichomonad and an associated spirochaete in the exudate removed by aspiration from the pleural cavity of a Chinaman in the Philippine General Hospital a few hours before death. We are unable at this time to offer an explanation as to how the flagellate gained entrance to the pleural cavity; but, the case having gone to autopsy, we shall report in detail on it in the near future.

a bacteria eater. It must be remembered that we are dealing only with the forms seen by us. Chatterjee, in his original paper(3) describing *Pentatrichomonas bengalensis*, makes only incidental mention of the ingestion of blood corpuscles, and we do not know whether or not his species feeds on bacteria. Derrieu and Raynaud do not discuss the nutrition of the species seen by them.

As a basis for future work looking to the clarification of the problem, it is suggested that *Trichomonas* and *Tetratrichomonas* might, for the present, be looked upon as feeding upon bacteria in the lumen of the bowel, and as occupying a position similar to that of *Entamœba coli;* while the species of *Pentatrichomonas* observed by us, and also probably by Chatterjee, may be regarded as a form subsisting on erythrocytes and possibly other tissue elements, and perhaps bearing the same relation to its host as does *Entamœba histolytica.* That these differences may exist within the genus is, of course, to be taken into consideration; that is to say, certain species of *Pentatrichomonas* may, like their cousins *Trichomonas* and *Tetratrichomonas*, subsist on bacteria solely, while others derive their nourishment from tissue elements alone, or may even adopt either method of nutrition under certain physical and chemical conditions obtaining in the particular environment in which they happen to find themselves at the time, or at some definite period in the life cycle. These are things that are to be determined by future investigation.

It is scarcely possible to go into the matter of tissue invasion on the basis of these observations, for that is purely conjectural. An autopsy on our case might or might not have developed interesting information on this point. Hadley, in his excellent studies on trichomoniasis in turkeys(7) has described in detail the mode of invasion of the intestinal wall through the goblet cells, and also the method by which the parasites later reënter the lumen of the intestine to complete their developmental cycle. We can, for the present, only surmise that such a thing might happen in man; but only histological study of the tissues in a case similar to ours can clear up that point. From his papers and from the study of preparations kindly sent to the senior author, we believe that Hadley has built up a strong case for *Trichomonas* in the intestine of the turkey. So far, the opportunity has been lacking to make the study of the liver sections sent by Doctor Hadley that they deserve, but we regard his work as forming a good basis of attack on the problem in man when favorable material becomes available. The fact that the

phenomena observed by us occurred in a child may have some significance in view of the well-known virulence of protozoal infections in children and in young animals. Mello-Leitao(10) lays particular stress on the virulence of flagellate infections in children and states his belief that the most frequently occurring type of dysentery in infants is of flagellate origin.

In the cases reported by Derrieu and Raynaud, and by Chatterjee, the bowel movements were dysenteric in character, as in our case. Derrieu and Raynaud also reported 14 per cent mononuclear leucocytes on the differential blood count. The mononuclear count is almost always of interest in protozoal infections, but unfortunately they say nothing in connection with their case as to the possibility of a concurrent malaria.

It has occurred to us that *Pentatrichomonas* may be the etiologic factor responsible for the outbreaks of so-called "epidemic flagellate dysentery" reported by so many workers in the tropics and elsewhere. On this point, Derrieu and Raynaud in their paper say:

> Nous devons signaler le caractère épidémique de cette variété de dysenterie. Notre malade nous a affirmé que les cas de diarrhée dysentériforme étaient nombreux dans la contrée qu'il habitait: certains de ses compagnons avaient gardé cette diarrhée pendant plusieurs mois, mais aucun n'avait été aussi gravement attreint que lui. Il nous a été impossible de faire une enquête sur place, à cette époque; elle aurait donné lieu très probablement à de curieuses constatations.

We also have in mind a supposed epidemic of flagellate dysentery at Parañaque, near Manila, in 1914, and mentioned by one of us,(8) in which many deaths occurred and for which no other cause except a trichomonad infection could be found.

We do not see the necessity for discussing at length the treatment of trichomonad infections. Suffice it to say that Derrieu and Raynaud claim to have cured their case by the administration of turpentine, by mouth and by enema. This is a form of treatment advocated in 1913 by Escomel, who later(6) used the same treatment in vaginal infections and introduced another treatment with iodine solution, either of which he claims will cure all cases. Derrieu and Raynaud noted the inefficacy of ipecac, collargol, neosalvarsan, urotropin, and sodium sulphate in their cases. Castellani has reported encouraging results, in some instances, in the treatment of flagellate infections with methylene blue.

Chatterjee seems to have met with poor success in the emetine treatment of his cases of dysentery associated with *Pentatrichomonas* infection. Only one of those he cites seems to have

responded at all to the drug. Chatterjee points out that there is danger of confusing these cases of flagellate dysentery with sprue, tuberculous diarrhœa, chronic amœbic dysentery, and the like. This point, we think, is well taken, and might with profit be borne in mind by practitioners unfamiliar with the perplexing manifestations in infections with the intestinal protozoa.

In conclusion we desire to thank Dr. José Albert, chief of the department of pediatrics for giving us access to the case, and Dr. Alberto Tupas, of the same department, who kindly furnished us the clinical data and coöperated with us in other ways.

REFERENCES

(1) BARLOW, NATHAN. Studies on Trichomonas. *New Orl. Med. & Surg. Journ.* (1916), 69, 299.

(2) BOECK, WILLIAM C. Mitosis in Giardia microti. *Univ. of Calif. Pub. in Zool.* (1917), 18, No. 1, 1.

(3) CHATTERJEE, G. C. On a five flagellate Trichomonas parasitic in man. *Indian Med. Gaz.* (1915), 50, 5.

(4) IDEM. Note on flagellate dysentery. *Indian Journ. Med. Res.* (1917), 4, 393.

(5) DERRIEU et RAYNAUD. Dysenterie chronique a flagelle nouveau. *Bull. Soc. path. exot.* (1914), 7, 571.

(6) ESCOMEL, E. Quelques remarques a propos dos Trichomoniases intestinale et vaginale. *Bull. Soc. path. exot.* (1917), 10, 553.

(7) HADLEY, PHILIP B. The role of the flagellated Protozoa in infective processes of the intestines and liver. Bull. 166, Agr. Exp. Station, Rhode Island State College, Kingston, R. I. (1916). The avenue and development of tissue-infection in intestinal trichomoniasis. Bull. 168, Agr. Exp. Station, Rhode Island State College, Kingston, R. I. (1916). The part played by the goblet cells in protozoan infections of the intestinal tract. *Journ. Med. Res.* (1917), 36, 79.

(8) HAUGHWOUT, F. G. The tissue-invasive powers of the flagellated and ciliated Protozoa with especial reference to Trichomonas intestinalis. A critical review. *Philip. Journ. Sci., Sec. B* (1918), 13, 217.

(9) KOFOID, C. A., and SWEZY, OLIVE. Mitosis and multiple fission in trichomonad flagellates. *Proc. Am. Acad. Arts & Sci.* (1915), 51, 296.

(10) MELLO-LEITAO. Cited by Fantham, Stephens and Theobald. The animal parasites of man. John Bale Sons & Danielsson, Ltd., London (1916), 624.

(11) MESNIL, F. Apropos du flagelle nouveau decrit par MM. Derrieu et Raynaud (Pentatrichomonas-Hexamastix D. et R., nec Alexeieff). *Bull. Soc. path. exot.* (1915), 8, 574.

(12) SHARP, ROBERT G. Diplodinium ecaudatum with an account of its neuromotor apparatus. *Univ. of Calif. Pub. in Zool.* (1914), 13, No. 4, 43.

ILLUSTRATION

PLATE I

[Figs. 1 and 2 were redrawn from camera lucida drawings of specimens fixed in Bouin's picro-aceto-formol solution, and stained with Dobell's alcoholic iron-hæmatein. Figs. 3 to 8 were redrawn from sketches made of the living organism during the process of feeding. Drawings by Haughwout.]

FIG. 1. Partially macerated individual showing disklike body, presumably an erythrocyte, lying in the cytoplasm.

2. Preparation showing further morphological details. Note the line of chromatinic granules lying in the cytoplasm between the axostyle and the parabasal.

FIGS. 3 to 7. Successive stages in the ingestion of an erythrocyte by a living specimen of *Pentatrichomonas*.

FIG. 8. Ingested erythrocyte lying in the cytoplasm at the posterior extremity of the parasite, and forming a bulge on the external surface of the body.

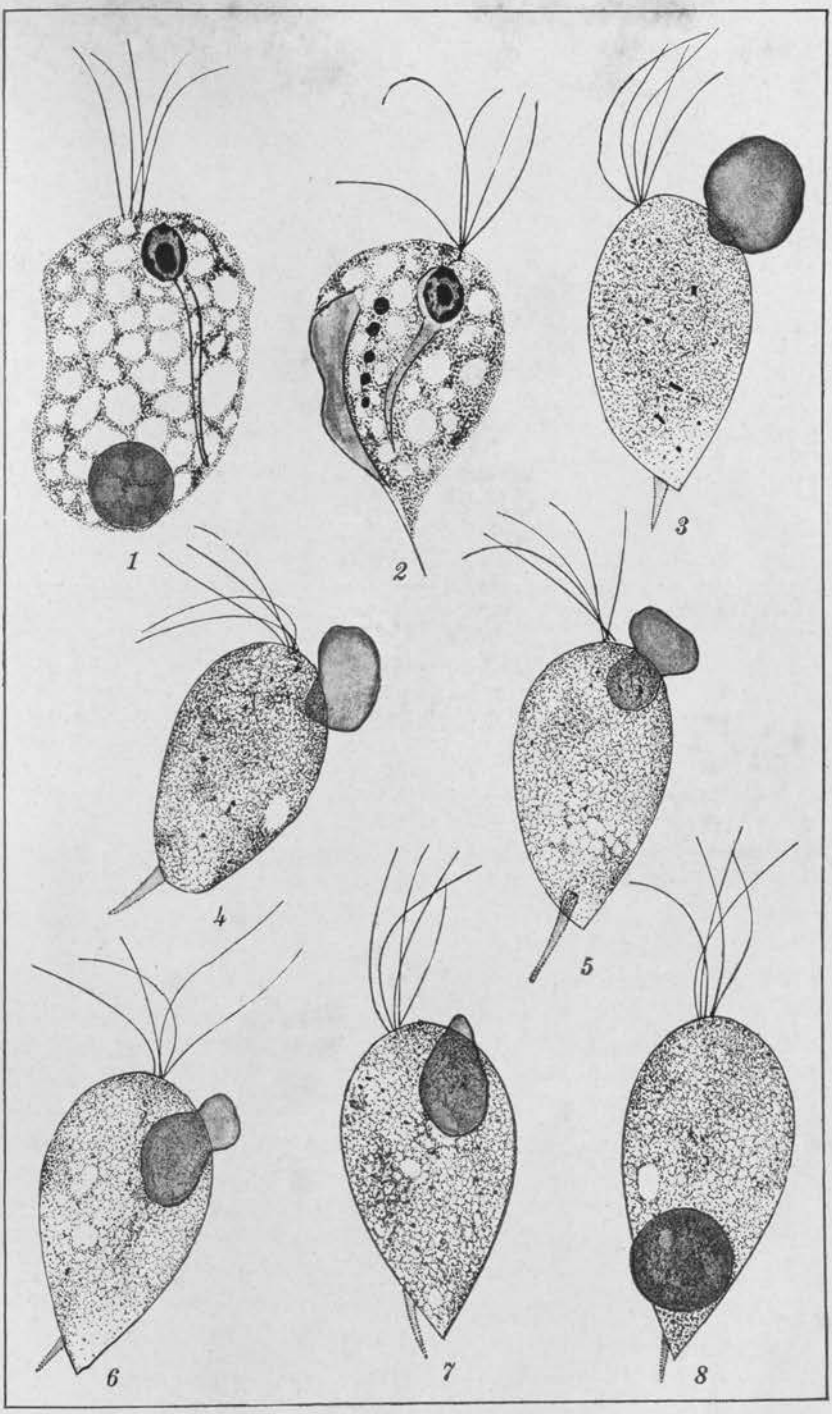


PLATE I. PENTATRICHOMONAS SP.

THE EFFECT OF CALCIUM SULPHATE ON CEMENT

SECOND PAPER

By J. C. WITT

(From the Chemical Laboratory, Bureau of Science, Manila)

TWO TEXT FIGURES

The first paper of this series [1] was a report of an investigation made at the Bureau of Science, Manila, to determine the effect of various amounts of calcium sulphate on a number of cements manufactured in the Orient. It was desired to learn the sensitiveness of these cements to calcium sulphate, the amount of this substance that could be present without harmful effects, and either to confirm or to refute some of the established principles of previous investigations. All the samples were prepared in the laboratory. Either finished cement or clinker was obtained, a calculated amount of gypsum or of some other form of calcium sulphate added, and then the two were placed in a small ball mill where they were ground and thoroughly mixed. The mixture was removed, analyzed for sulphuric anhydride (SO_3), and subjected to the usual physical tests.

In conformity with previous work it was found that in general the time required for the initial set was directly proportional to the amount of sulphuric anhydride present [2] until a certain point was reached, but further additions quickened the set.[3] This maximum point corresponded to from 1.5 to 2 per cent sulphuric anhydride. With more than 2 per cent sulphuric anhydride the tensile strength was likely to decrease, and with more than 3 per cent considerable expansion in sea water was likely to result. The soundness was independent of the sulphuric anhydride content.

After the first paper was completed, some phases of the investigation were continued. It developed that one of the cements was very irregular in setting time. Several series of samples were prepared, and sulphuric anhydride–setting time

[1] *Philip. Journ. Sci., Sec. A* (1917), 12, 133.

[2] Many other electrolytes have this effect. See *Philip. Journ. Sci., Sec. A* (1916), 11, 273; (1918), 13, 29.

[3] Several references to the influence of substances on cement and concrete are given in the papers referred to in footnotes 1 and 2 and are not repeated here.

curves were plotted, but no two of these curves resembled each other. At the plant where this cement was manufactured similar irregularity was also noted, and considerable difficulty was experienced in controlling the addition of gypsum. Some samples taken from the conveyors, having a low sulphuric anhydride content, were normal [4] in set, while others, with much higher content, had a flash set. In such cases the other physical tests showed no essential differences; nor were there sufficient differences in chemical analyses to account for the irregularity. It developed further that samples prepared in the laboratory by crushing the clinker and grinding it in a small ball mill did not have the same behavior as the cement which had been ground in a large mill at the plant.[5]

Most of the work reported in the present paper was carried out to solve the problem of satisfactory gypsum control for the cement in a single plant and with no intention of publishing the results. To obtain the number of results necessary to accomplish the desired purpose it was necessary to work with one cement alone, even though an investigation of several simultaneously would have contributed more to the general subject.

All physical tests have been made in accordance with United States Government specifications for Portland cement,[6] except that the ball method for normal consistency has been used, and no effort has been made to control room temperature (usually 25° to 35° centigrade). The setting time as determined by the Gillmore needles is given to the nearest ten minutes, and any value less than five has been called zero. As a rule the final set has been omitted in the tables, because most of the irregularity has been noted with the initial set. The normal consistency is given only when it shows some characteristic of interest. Most of the samples have been analyzed individually, but a few of the values were calculated from the sulphuric anhydride content of the clinker and of the gypsum. In Table I the samples shown as containing no sulphuric anhydride were not analyzed. No gypsum was added, but the clinker contained a trace. The tests were made at different times and by different operators, so that some slight variation may be due to personal equation. Samples that gave the most erratic results have purposely been

[4] In this paper, "normal set" means a satisfactory initial set—usually two to four hours.

[5] For simplicity, samples ground from clinker in a laboratory mill will be called "laboratory samples" while those taken from the conveyors in the plant will be called "plant samples."

[6] No. 59 C1a, January 1, 1917.

included. In Table I are shown some tests on laboratory samples which have been made from time to time. For convenience in comparison, they have been arranged in the order of their sulphuric anhydride content.

Commercial cements clinkered in rotary kilns require the addition of some substance subsequent to burning. I have never found a cement either in the United States or in the East that did not contain calcium sulphate, though of course the amount varies greatly with conditions. This cement, however, is an exception, when ground in a laboratory mill. Only one of several samples ground without the addition of gypsum was quick setting, and that one required only a small addition of gypsum to give a normal set. Further, the addition of gypsum has little effect on the setting time. The results obtained with laboratory samples are irregular when considered individually, but if those for each half per cent sulphuric anhydride are averaged (omitting the samples having a flash set, and calculating to round numbers) we have the following, which show that the average setting time is apparently independent of the sulphuric anhydride content:

Sulphuric anhydride. Per cent.	Time of set. Minutes.
0.50 to 1.00	200
1.01 to 1.50	250
1.51 to 2.00	220
2.01 to 2.50	230
Above 2.50	240

Table II shows some of the results obtained with plant samples, likewise arranged with reference to their sulphuric anhydride content. Averaging these results, we have

Sulphuric anhydride. Per cent.	Time of set. Minutes.
Less than 1.80	33
1.80 to 2.00	161
Above 2.00	171

Many plant samples below 1.80 per cent sulphuric anhydride are quick setting. With percentages greater than 1.80, the average sample has a normal set, though the period is not so long as for the laboratory sample containing no retarder. The samples shown in Table II were taken from the conveyors at the plant in the course of control work extending over several months. Samples were taken regularly every half hour, and when one was found to be quick setting, it was put aside for analysis and further examination.

The data given in the first two tables may be readily understood by reference to fig. 1. The setting time of each sample is plotted against the sulphuric anhydride content. The plant samples are designated by ○ and the laboratory samples by +. The line representing sixty minutes, the minimum initial set allowable under Government specifications when Gillmore needles are used, and the lines representing 1.80 per cent and 2.10 per cent sulphuric anhydride, respectively, are made heavy for the sake of comparison. The last named is the upper limit of sulphuric anhydride content allowable under Government specifications.

SPECIAL PLANT TEST

By referring to fig. 1 it will be noted that only four plant samples below 1.50 per cent were included. Cement had not been regularly manufactured below this amount, and no such

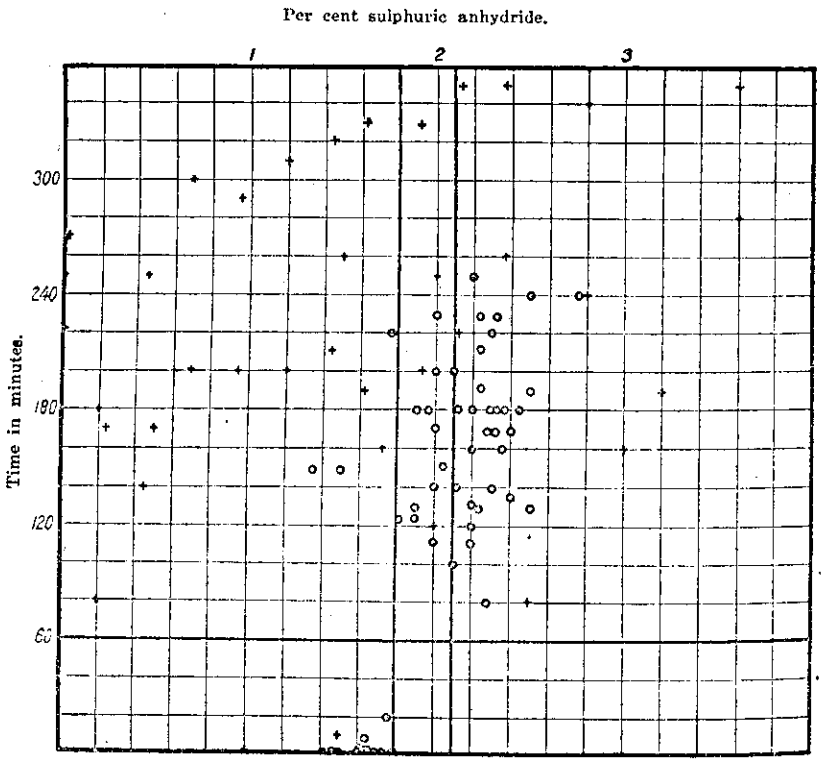


FIG. 1. Showing the relation of initial set to sulphuric anhydride content.

plant samples were available. The first cement was made with 1.50 per cent sulphuric anhydride but was found unsatisfactory, and since then the calculated amount had been gradually

raised to bring the setting time within the required limits. A number of laboratory samples low in sulphuric anhydride had been studied, but no conclusions concerning the regular product could be drawn. It often has been found that when an electrolyte is mixed with a cement there is a maximum point in the setting-time curve. When a given amount of the electrolyte is present, the cement will have the slowest set—either less or more of the substance causing a quicker set. The peculiar behavior of the plant samples in requiring so much calcium sulphate to produce a normal set and the results obtained with laboratory samples containing little or none of the retarder suggested the possibility that the optimum sulphuric anhydride content was at some point below 1.50 per cent. In that event, the difficulty in the manufacture was that the sulphuric anhydride was always above the optimum point.

Arrangements were made by which the output of a tube mill for a number of hours was taken for the experiment. A quantity of clinker recently made and known to be very uniform was selected. Sufficient gypsum was mixed, sampled, and analyzed. At 6 o'clock in the morning the mill was started; it was run twelve hours in the usual manner, keeping the sulphuric anhydride at approximately 2 per cent. The cement was tested repeatedly during the day and was found to be normal in every respect. At 6 in the afternoon all additions of gypsum were stopped and clinker alone was fed to the mill until 9 o'clock, after which gypsum was added as before. From 6 p. m. until 1 a. m. samples of 4 or 5 kilograms each were taken every half hour, and at times every fifteen minutes. Physical tests were started at once, and the following day each sample was analyzed for sulphuric anhydride. The results are shown in Table III. Samples 1 to 4 and 15 to 18 gave satisfactory tests for soundness. The others could not be tested because they were quick setting. The normal consistency of all samples tested was the same. The fineness did not vary greatly during the run. The lowest point reached in sulphuric anhydride content was 0.62 per cent. It would have been difficult to obtain a lower result than this unless the tests had continued a long time, because the cement was run through an air separator, and the cement returning to the mill always carried considerable sulphate. The test demonstrated that satisfactory cement could not be made with a small amount of the retarder, because only one sample having less than 1.50 per cent sulphuric anhydride had a normal set.

The construction of fig. 2 is based on the results in Tables I, II, and III, and several hundred other analyses and physical tests. The figure is a diagram showing in general the relation of sulphuric anhydride content, from 0 to 2.50 per cent, to the setting time, in both plant and laboratory samples. Because of the considerable variation areas have been substituted for the usual graphs. The shaded areas represent plant sam-

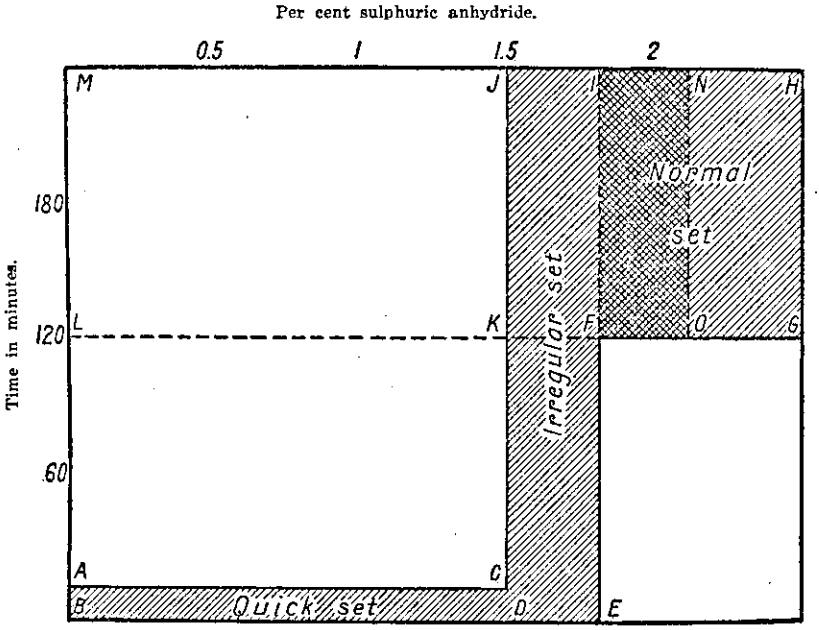


FIG. 2. Diagram showing the relation of initial set to sulphuric anhydride content.

ples. When the sulphuric anhydride content of a cement is less than 1.50 per cent, it will set in only a few minutes and its place on the diagram is within the rectangle *ACDB*. Between 1.50 and 1.80 per cent, the behavior is erratic. It may have a flash set or a normal set—rectangle *DJIE*. Above 1.80 per cent, the cement has a setting time of two to four hours. The area *MHGL* shows the behavior of laboratory samples. The average time of set is the same, with or without gypsum.

CONTROL OF GYPSUM AT THE PLANT

On the basis of the diagram just described, the gypsum control at the plant was adjusted a year ago and there has been no further difficulty with that phase of the manufacture. With the present raw materials and plant equipment, the sulphuric anhydride content must be kept between 1.80 per cent and 2.10

per cent. If less than 1.80 the set cannot be depended upon, and if greater than 2.10 the cement will not conform to Government specifications. This area is shown by the darkly shaded rectangle *INOF* (fig. 2).

At many plants the allowable variation in sulphuric anhydride is considerably greater than 0.3 per cent, and sufficient accuracy may often be obtained by measuring the gypsum; that is, by adding a certain volume to a given weight or volume of the clinker. This method was used formerly, and in a day's run the maximum variation of sulphuric anhydride was 0.46 per cent. By exercising greater care and stricter supervision, this was lowered to 0.30 per cent. With such small limits allowable, this was still not sufficiently accurate and other changes were made. It was found necessary to weigh both gypsum and clinker. Two small bins were made, each containing sufficient gypsum for a two-days' run of the mill. The gypsum to fill one of them is thoroughly mixed, and sampled as it is placed in the bin, and then analyzed. The weight of gypsum added to the clinker is calculated from this analysis. While the first bin is being used, material for the second is prepared. By this method the maximum variation for a day's run may be kept as low as 0.17 per cent. By comparing many analyses of the finished cement with the theoretical sulphuric anhydride content calculated from the mix, it has been found that on account of irregularities such as the sulphuric anhydride in the clinker, the loss of water in the gypsum during grinding, the loss of gypsum from dusting, and the like, there is practically a constant variation which can be corrected in the original calculation of the mix. Taking this into account, the sulphuric anhydride content can be kept within a few hundredths per cent of the calculated value.

THE EFFECT OF EXPOSURE TO THE AIR, AND OF HYDRATED LIME, IN PRESENCE OF CALCIUM SULPHATE

A cement may contain sufficient gypsum to render it normal setting at the time of manufacture, but may lose the effect of the retarder when exposed to the air. Quick-setting cement may also become normal under the same conditions. The effect of air exposure on a number of the samples in Table III was investigated. It has been shown that the effect of the atmosphere extends only a few millimeters below the surface,[1] but conditions more severe than cement is ever subjected to during

[1] *Philip. Journ. Sci., Sec. A* (1910), 5, 398.

storage were arranged. The cement was spread out in thin layers and thoroughly mixed from time to time to expose new surfaces. At intervals, portions were removed and tested for setting time. The results are shown in Table IV. Sample 13, with 0.62 per cent sulphuric anhydride, changed from a flash set to a normal set; sample 15, 1.72 per cent, changed from normal to quick setting; No. 1, 2.15 per cent, remained slow setting; No. 4, 1.92 per cent, became quick setting in nine days, but had returned to normal at the end of eighty-five days. In this series of experiments, it is evident that the effect of exposure is practically independent of the sulphuric anhydride content.

Hydrated lime is said to retard the set of cement.[8] Some tests were made to determine its effect in the presence of various amounts of gypsum. Cement having a flash set and containing 1.50 per cent sulphuric anhydride was used. Gypsum ground to equal fineness and containing 35.81 per cent sulphuric anhydride was mixed with this cement in proportions to give cements of 1.65, 1.75, and 2.00 per cent sulphuric anhydride, respectively. To the original cement and to each of the mixtures were then added 0.5, 1, and 2 per cent hydrated lime, respectively. The setting time of each mixture was then determined, and the results are shown in Table V. The effect of the lime is apparently independent of the sulphate present. The normal consistency increases with the lime present.

POSSIBLE CAUSES OF IRREGULARITY

The peculiar irregularity of this cement is difficult to explain. A number of quick-setting samples have been analyzed and the analyses compared with those of slow-setting samples having a lower sulphuric anhydride content. Some differences were found, but they were not sufficiently large to account for the irregularity. The cement is somewhat higher in iron and in alkalies than the average cement, but otherwise there is nothing unusual in its composition. High iron content should not make cement quick setting.[9] The various alkalies are present in constant amounts and therefore should have a uniform influence, unless their effect is caused to vary by changes taking place during the manufacturing process.

Since the irregularity has not been accounted for on the basis

[8] Carpenter, R. C., *Eng. Rec.* (1904), 50, 769; Meade, R. K., Portland Cement. Easton, Pa., The Chemical Publishing Co. (1911), 424.

[9] Meade, op. cit., 35.

of analyses, an explanation was sought on the basis of physical changes, or of chemical changes in the constituents, of such a nature that they could not be detected by analysis. It is believed that the irregularity results from changes that go on during the grinding of the clinker, though it has not been proved that such are entirely responsible. Slight variations in heat treatment in the kiln may partly account for it. However, it has been observed in connection with the grinding that such factors as the rate at which the clinker is fed to the mill, the hardness of the clinker, the relative size of the pieces, and the heat generated during the process have their effect.

With reference to the grinding, the following explanations of the irregularity of cement ground at the plant, and between the regular product and samples ground in a laboratory mill [10] have been offered:

1. The heat generated during grinding at the plant causes the formation of alkali carbonates, which influence the set of the finished cement. (A high temperature is often reached, and the clinker is high in alkalies.)

2. Though the 200-mesh fineness of the plant samples and of the laboratory samples is practically the same there may be a considerable difference in the fine particles that pass the sieve.

Neither of these hypotheses has been verified. On the contrary, there is evidence against them. A series of tests reported in the first paper of this series [11] shows that the set is only slightly affected by the presence of sodium carbonate. Therefore, even if considerable quantities of alkaline carbonates were found during grinding, the irregularity of set could not be accounted for on that basis. The tensile strength of laboratory samples and of plant samples is approximately the same. This would not be likely to be so, if the latter contained an appreciably greater percentage of fine particles.

SUMMARY

The cement under investigation is unique in its setting qualities when treated with calcium sulphate. If the clinker is ground in a small laboratory mill, its average time of set is independent of the amount of sulphate added. When ground in

[10] No. 1 was suggested and communicated to me by another investigator.
[11] Loc. cit.

the regular way at the plant, however, it must have a sulphuric anhydride content of 1.80 per cent to insure a normal set.

Considerable difficulty was experienced in controlling the gypsum content until many physical tests and chemical analyses had been made, and the limits of the sulphuric anhydride determined.

The effects of exposure to air and of additions of hydrated lime are independent of the sulphuric anhydride content.

Soundness is independent of the sulphuric anhydride content. Normal consistency is independent of sulphuric anhydride content, but increases with the amount of hydrated lime present.

TABLE I.—*Setting time of cement ground in laboratory.*

Sulphuric anhydride.	Initial set.	Sulphuric anhydride.	Initial set.	Sulphuric anhydride.	Initial set.	Sulphuric anhydride.	Initial set.
Per cent.	*Min.*	*Per cent.*	*Min.*	*Per cent.*	*Min.*	*Per cent.*	*Min.*
0	0	0.71	300	1.66	330	2.79	260
0	250	0.96	200	1.75	160	2.79	340
0	270	0.96	230	1.89	220	3.00	160
0	270	1.00	0	1.89	330	3.20	190
0.22	80	1.20	200	2.00	120	3.63	280
0.22	180	1.20	310	2.00	250	3.63	350
0.25	170	1.43	210	2.12	220	5.00	170
0.46	140	1.43	320	2.12	350	9.10	140
0.46	250	1.50	10	2.35	260	.....	.....
0.50	170	1.50	260	2.35	350	.....	.....
0.71	200	1.66	190	2.50	80	.....	.....

TABLE II.—*Setting time of cement ground in plant.*

Sulphuric anhydride.	Initial set.	Sulphuric anhydride.	Initial set.	Sulphuric anhydride.	Initial set.	Sulphuric anhydride.	Initial set.	Sulphuric anhydride.	Initial set.
Per cent.	*Min.*	*Per cent.*	*Min.*	*Per cent.*	*Min.*	*Per cent.*	*Min.*	*Per cent.*	*Min.*
1.35	150	1.75	20	2.04	150	2.25	230	2.44	180
1.45	0	1.75	220	2.10	140	2.26	130	2.50	130
1.45	0	1.80	0	2.11	100	2.27	80	2.50	240
1.45	0	1.82	125	2.11	200	2.28	170	2.51	120
1.50	0	1.87	125	2.13	180	2.29	180	2.75	240
1.52	0	1.87	180	2.18	250	2.30	140	.....	.....
1.52	160	1.91	130	2.19	120	2.31	220	.....	.....
1.59	0	1.92	180	2.20	130	2.32	180	.....	.....
1.61	0	1.95	180	2.22	110	2.33	170	.....	.....
1.61	0	2.00	110	2.22	160	2.33	230	.....	.....
1.62	0	2.00	230	2.22	160	2.35	160	.....	.....
1.65	10	2.02	140	2.22	200	2.36	180	.....	.....
1.68	0	2.02	170	2.23	210	2.39	135	.....	.....
1.74	0	2.03	200	2.25	190	2.41	170	.....	.....

TABLE III.—*Mill test to establish relation between sulphuric anhydride and setting time.*

Sample No.	Time.	Sulphuric anhydride.	Normal consistency.	Initial set.	Final set.	Fineness (200-mesh).
	p. m.	*Per cent.*		*Min.*	*Min.*	
1	6.00	2.15	24	170	270	89.0
2	6.30	2.15	24	140	270	
3	7.00	2.06	24	150	290	87.2
4	7.30	1.92	24	190	270	
5	8.00	1.13		55	130	87.8
6	8.30	0.96		flash		
7	8.45	0.93		flash		
8	9.00	0.89		flash		88.9
9	9.15	0.82		flash		
10	9.30	0.79		flash		
11	9.45	0.75		flash		
12	10.00	0.69		flash		89.5
13	10.30	0.62		flash		
14	11.00	1.13		flash		89.6
15	11.30	1.44	24	170	220	
	a. m.					
16	12.00	1.72	24	130	230	86.2
17	12.30	1.64	24	170	230	
18	1.00	1.54	24	150	280	85.2

TABLE IV.—*Effect of exposing cement of various sulphuric anhydride contents to the atmosphere for different periods of time.*

Sample No.	Test.	Days of exposure.						
		None.	2.	4.	9.	16.	32.	85.
1	Initial set ..... min..	170	200	240	240	210	300	170
1	Final set ..... min..	270	400	450	300	600	540	260
1	Normal consistency	24	24	24	24	25	33	33
4	Initial set ..... min..	190	190	250	10	15	35	100
4	Final set ..... min..	270	380	450	150	160	45	170
4	Normal consistency	24	24	24	24	24	33	33
5	Initial set ..... min..	55	0	35	3	7	25	80
5	Final set ..... min..	125	0	300	220	160	35	160
5	Normal consistency	24	24	24	24	25	33	33
13	Initial set ..... min..	0	0	25	260	200	70	90
13	Final set ..... min..	0	0	720	620	730	(a)	120
13	Normal consistency	24	24	24	24	29	29	33
15	Initial set ..... min..	170	10	120	10	10	25	45
15	Final set ..... min..	220	350	540	280	140	40	170
15	Normal consistency	24	24	24	24	24	29	33
16	Initial set ..... min..	130	140	270	10	10	15	55
16	Final set ..... min..	280	350	250	160	160	30	120
16	Normal consistency	24	24	24	24	24	29	33
17	Initial set ..... min..	170	125	190	5	5	15	60
17	Final set ..... min..	230	330	330	200	100	30	140
17	Normal consistency	24	24	24	24	24	29	33

[a] Time of set indefinite but more than twenty-four hours.

TABLE V.—*Effect of hydrated lime, in presence of various amounts of gypsum.*

Sample No.	Gypsum added (grams per kilo).	Calculated per cent SO_3.	Normal consistency.	Initial set in minutes.			
				With no addition of lime.	With 0.5 per cent lime.	With 1 per cent lime.	With 2 per cent lime.
			Per cent.				
1	0	1.50	25	0	10	5	45
2	4.2	1.65	26	5	65	40	80
3	7.0	1.75	27	20	60	65	110
4	14.0	2.00	28	105	125	145	160

ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Diagram showing the relation of initial set to sulphuric anhydride content. 233

2. Diagram showing the relation of initial set to sulphuric anhydride content. 233

EXPERIENCE WITH METHYLENE BLUE-EOSIN LACTOSE AGAR IN SEARCHING FOR BACILLUS DYSENTERIÆ IN STOOLS

By C. S. PAÑGANIBAN and O. SCHÖBL

(*From the Serum Section, Bureau of Science, Manila*)

In the absence of suitable enrichment and selective media the isolation of *Bacillus dysenteriæ* from stools is handicapped by certain difficulties. It is true that in cases of acute bacillary dysentery the colonies of *B. dysenteriæ* that develop on the plates are at times numerous, and that practically no other colonies are found. On the other hand, experience teaches that even in a typical acute dysenteric stool the laboratory test fails to isolate *B. dysenteriæ*. If amœbæ be present in such a specimen, the clinician may easily be misguided and decide the case as amœbic dysentery. The clinical picture and the course of the disease may guide the clinician in the differential diagnosis of a particular dysentery case; but the clinical picture of either of the two forms of dysentery is surely not typical in every case, else the examination of stools for *B. dysenteriæ* would not be so persistently insisted upon by clinicians as it usually is, and rightly so.

The presence of amœbæ in acute dysentery stools does not necessarily exclude bacillary dysentery. One must consider the comparatively high percentage of amœbæ contact carriers. Furthermore, a superposed bacillary infection in a chronic case of amœbic dysentery is not so rare an occurrence as would appear at first thought. The theory advanced from some quarters that an attack of bacillary dysentery confers immunity and, therefore, if the patient gives history of previous attacks of dysentery it is amœbic and not bacillary dysentery is even theoretically untenable. Granted that the previous attacks were due to amœbic infection, this supposition does not prove that the present illness is not bacillary dysentery for the reason mentioned above.

From these considerations it is clear that the bacteriological diagnosis of bacillary dysentery is highly desirable. Hence any improvement in the laboratory technic which tends to facilitate the detection of *B. dysenteriæ* in stools will be welcomed by the laboratory worker as well as by the clinician.

It has been the good fortune of one of us to witness for some time the working out of the methylene blue-eosin plate by the authors [1] of this medium. They found it a very convenient medium in the bacteriological diagnosis of typhoid fever. *Bacillus dysenteriæ* and *B. typhosus* behave identically with regard to acidification of lactose. It naturally occurred to us to employ the methylene blue-eosin lactose agar in the bacteriological diagnosis of bacillary dysentery. Since we began work a paper by Meyer and Stickel,[2] which deals with the same subject, has been published. It is pleasing to note that our experience coincides with that of these workers.

During an outbreak of bacillary dysentery in Manila in 1918, we had an opportunity of subjecting the methylene blue-eosin lactose plate to a practical test as to its suitability in bacteriological diagnosis of bacillary dysentery. The stools were taken at random from hospital patients. Each stool was plated directly on litmus lactose agar and on methylene blue-eosin lactose agar. An equal amount of material was smeared on the surface of each plate.

In case of typical dysenteric stools a flake of bloody mucus was fished out, washed in salt solution, and smeared on the surface of the plate. Liquid or fæcal stools were used in four dilutions. A standard size loopful of each dilution was plated. The plates were incubated overnight. Colorless colonies were thoroughly searched for, and agglutination test was performed in hanging drop. Those colonies that showed positive agglutination were transplanted in sugar media for identification of the type. The advantages of the methylene blue-eosin plate, as given by the originators of this medium in typhoid diagnosis, were found to hold true in our examinations. Bacillary dysentery was found to form small colorless colonies, the various types of *B. dysenteriæ* showing no particular differences of growth.

The results of these examinations, thirty-eight specimens in all, are given in Table I.

Of the thirty-eight stools examined thirty-three were found positive. While the lactose litmus plate gave positive results in twenty-nine specimens (76 per cent), the methylene blue-eosin lactose plate showed a superiority of 8 per cent, giving positive results in thirty-two specimens (84 per cent). This is not the only advantage gained by the use of this medium; but, also, the

[1] Holt-Harris, J. E., and Teague, Oscar, *Journ. Infect. Dis.* (1916), 18.
[2] Meyer, V. F., and Stickel, J. E., *Journ. Infect. Dist.* (1918), 23.

time necessary for the detection of *B. dysenteriæ* on this medium was much shorter as compared with the labor required to confirm the positive findings on the lactose litmus plate.

CONCLUSION

The methylene blue-eosin lactose medium designed by Holt-Harris and Teague, as modified by Meyer and Stickel and by us, is a considerable improvement in diagnostic technic.

We wish to thank Dr. P. T. Lantin, of the Philippine General Hospital, who kindly supplied us with the material.

TABLE I.—*Stool examinations.*

Specimen.	Serial No.	Lactose litmus plate.	Methylene blue-eosin plate.
4-10	1	+	+
5-58	2	+	+
5-23	3	+	+
5-27	4	+	+
45352	5	—	+
952	6	—	—
3-55	7	+	—
5-49	8	+	+
6-36 (63030)	9	+	+
6-18	10	+	+
6-26	11	+	+
5-61	12	+	+
5-53	13	+	+
5-50	14	+	+
3-359	15	+	+
5-53 Vazco	16	+	+
6-54 Matilde	17	+	+
5-60 Zuarez	18	+	+
5-55 Juan	19	+	+
5-70 Espinosa	20	—	+
5-56 Paguis	21	+	+
5-25 Catagayan	22	+	+
5-70 Espinosa	23	+	+
5-59 Balatbat	24	+	+
4-10 Beatriz	25	+	+
6-26 Ma. Fajardo	26	+	+
5-53 Telesforo	27	+	+
6-55 Ciriaca	28	+	+
5-58 Teydon	29	—	—
6-50 J. Aguilar	30	+	+
4-8 F. Madagep	31	+	+
4-6 Josefa Gy	32	+	+
5-58 Teydon	33	—	—
4-60 Praxides	34	+	+
4-9	35	—	—
3-361	36	—	+
3-345	37	—	—
57133	38	—	+

NOTES ON THE FLORA OF SUMATRA

By E. D. MERRILL

(From the Botanical Section of the Biological Laboratory, Bureau of Science, Manila)

In the year 1860–61 Miquel[1] published a general summary of the Sumatran flora, enumerating all the species of Spermatophyta then known from the island and the neighboring smaller ones, especially Bangka. This work was based primarily on the collections of *Teysmann, Diepenhorst, Horsfield, Korthals, Junghuhn, Zollinger,* and *Amman,* and includes 2,642 species, of which about 700 were described by Miquel as new. Since Miquel's publication was issued, comparatively little has been published on the Sumatran flora as such. Some large collections of plants have been made, notably that by *Beccari,* but with the exception of the recent collections of *Robinson* and *Kloss,* those made by other botanists since Miquel's time have not been thoroughly studied.

In 1884 Van Hasselt and Boerlage[2] published a small contribution to our knowledge of the Sumatran flora, this being based on the relatively unimportant botanical collections made by the Veth expedition in connection with its anthropological and zoölogical investigations. In this work about 170 species are enumerated, a large number of them cellular cryptogams. Of the spermatophytes but four are described as new, most of the others enumerated having already been recorded from Sumatra.

The Sumatran collections made by Dr. S. H. Koorders in 1890 have been enumerated by Mrs. Koorders,[3] these totaling not more than 450 species in all groups, a considerable number of which have been determined only to the genus, and some only to the family. Of these species collected by Doctor Koorders

[1] Miquel, A. F. W., Florae Indiae Batavae. Supplementum I. Prodromus Florae Sumatranae (1860–61) XX + 1–656, *t. 1–4.* German edition, Sumatra, seine Pflanzenwelt und deren Erzeugnisse (1862) XXIV+1–656, *t. 1–4.*

[2] Van Hasselt, A. L. and Boerlage, J. G., Bijdragen tot de kennis der flora van Midden-Sumatra, in Veth, P. J. Midden-Sumatra 4 part 2 (1884) 1–49, *t. 1–8.*

[3] Koorders-Schumacher, A., Syst. Verzeich. Herb. Koord. 2 (1910–11) 1–62.

in Atjeh and in central Sumatra, about 30 were described as new. A high percentage of the others enumerated had already been recorded from Sumatra by Miquel.

The most important recent publication on the Sumatran flora as such is that by Ridley and others on the botany of Mount Korinchi, based on the collections of Messrs. H. C. Robinson and C. Boden Kloss.[4] In this publication 813 species are enumerated, of which 1 genus and 143 species are described as new. The percentage of novelties in this collection is certainly no less than can reasonably be expected from general collections made in any unexplored part of Sumatra where botanizing is largely confined to the forested areas. Among the previously described species enumerated by Ridley are naturally many that were already known from Sumatra, but there is also a considerable number originally described from other regions that had not previously been recorded from that island.

Sumatran species have been published from time to time in the extensive botanical periodical literature and in monographs of various natural groups. Including such species and those listed in the few publications wholly based on the Sumatran flora that have been issued since 1862, it is very doubtful if the list of species definitely known from Sumatra has been increased by more than 500 in all groups since the publication of Miquel's work. The list of Sumatran species known to-day would probably approximate about 3,000 in the spermatophytes alone, an indication of our lack of knowledge of the Sumatran flora as compared with other areas in the Malayan region, such as Java, with about 5,000 known species, Borneo with about 4,900 known species, and the Philippines with about 8,000 known species. On account of its large size, its varied climatic conditions, and its numerous high mountains, Sumatra can scarcely be less rich and varied in its flora than are the Malay Peninsula, Borneo, Java, and the Philippines; and from my present knowledge of the floras of these regions I should consider it very doubtful if we know more than one-third of the species that actually occur in Sumatra at the present time.

I have recently received for identification Sumatran collections aggregating about 500 numbers, made under the direction of Messrs. H. H. Bartlett and C. D. La Rue, chiefly in the vicinity of Asahan, East Coast. While the material represented in this collection for the most part represents rather common and widely

[4] Results of an expedition to Korinchi Peak, Sumatra, Botany, *Journ. Fed. Malay States Museums* 8 (1917) 1–145, *t. 1–4*.

distributed Malayan species, there are a few apparently undescribed forms, and a considerable number of known species previously not recorded from Sumatra. The collections were apparently made, for the most part, at low altitudes in the settled areas and in the second-growth forests; few species characteristic of the primary forests are represented. It is a well-known fact that collections made in any part of the Malayan region at low altitudes outside of the primary forest invariably present a high percentage of widely distributed species and hence those that are thoroughly well known. The endemic elements of any insular flora in Malaya—and the percentage of endemism is usually high in each of the larger islands of the Malay Archipelago—are for the most part confined to the primary forests. With our present state of knowledge of the Sumatran flora I have not considered it advisable to publish an enumeration of this collection, but have recorded some species, for the most part not previously credited to Sumatra, and also give below the descriptions of a few apparently undescribed species detected while studying the material.

URTICACEAE

DEBREGEASIA Gaudichaud

DEBREGEASIA LONGIFOLIA (Burm. f.) Wedd. in DC. Prodr. 16[1] (1869) 235.[24]

Urtica longifolia Burm. f. Fl. Ind. (1768) 297.

Karoland, Kaban Djahe, *Bartlett & La Rue 81,* with the local name *tjeppira.*

India to Java and the Philippines.

OREOCNIDE Miquel

(*Villebrunea* Gaudichaud)

OREOCNIDE NIVEA sp. nov.

Frutex vel arbor parva, ramulis villosis; foliis chartaceis, ellipticis ad elliptico-obovatis, 12 ad 17 cm longis, supra olivaceis, subtus niveis et densissime tomentosis, apice acuminatis, margine serrato-dentatis, nervis utrinque circiter 12, perspicuis; inflorescentiis fasciculatis, capitulis longe pedunculatis, globosis, 5 mm diametro.

A shrub or small tree, the branchlets and petioles rather densely villous with pale brownish hairs. Leaves chartaceous, elliptic to elliptic-obovate, penninerved, 12 to 17 cm long, 6 to 8 cm wide, serrate-dentate except at the base, the upper surface olivaceous when dry, the midrib and nerves more or less pubescent, the epidermis with few, scattered, rather long, white

hairs, the lower surface white, densely tomentose, the pubescent midrib, nerves, and reticulations brownish, the base usually rounded, the apex shortly and sharply acuminate; lateral nerves about 12 on each side of the midrib, distinct, the petioles about 1.5 cm long; stipules lanceolate, acuminate, about 1 cm long. Inflorescences fascicled, axillary and from the axils of fallen leaves, the branches up to 2 cm long, simple, or bearing 2 or 3 heads, somewhat pubescent, the heads globose, about 5 mm in diameter. Achenes crowded, sessile, somewhat hispid, oblong-ovoid, narrowed upward, about 1.5 mm long.

SUMATRA, East Coast, Asahan, in mountain jungle at Linaboen, June 30, 1910, *Bartlett & La Rue 213*, with the local name *nderasi*.

This species is readily distinguished from all previously described forms of the genus by its leaves being white beneath in striking contrast to the dark-olivaceous upper surface.

OLACACEAE

ERYTHROPALUM Blume

ERYTHROPALUM SCANDENS Blume Bijdr. (1826) 921.

Karoland, Lau Bakal, *Bartlett & La Rue 170*, June 20, 1918. India to Java and the Philippines.

LAURACEAE

LITSEA Lamarck

LITSEA UMBELLATA (Lour.) comb. nov.

Hexanthus umbellatus Lour. Fl. Cochinch. (1790) 196.
Litsea hexantha Juss. in Ann. Mus. Paris 6 (1805) 212.
Litsea amara Blume Bijdr. (1825) 563.

Karoland, Kampong Lingga, *Bartlett & La Rue 115*, June 5, 1918.

Loureiro's type is preserved in the herbarium of the British Museum, where it was examined by R. Brown, who thought it to represent the Australian species described by him as *Tetranthera ferruginea*. It is clear that Brown was in error in making this reduction, for Loureiro's species is apparently identical with the widely distributed Malayan one currently known as *Litsea amara* Blume, of which I have numerous specimens from Indo-China, the Malay Peninsula, and Java. The Australian species currently known as *Litsea ferruginea* (R. Br.) Benth. & Hook. f. needs a new name as the specific name is invalidated in *Litsea* by *L. furruginea* Blume; it should be known as Litsea leefeana (F. Muell.) (*Cylicodaphne leefeana* F. Muell.).

LITSEA PERAKENSIS Gamble in Kew Bull. (1910) 359, Journ. As. Soc. Beng. 75[1] (1912) 160.

Karoland, Kampong Lingga, *Bartlett & La Rue 117*, June 6, 1918.

Perak, Johore, Singapore.

LEGUMINOSAE

DESMODIUM Desvaux

DESMODIUM VIRGATUM Zoll. Nat. Geneesk. Archip. Ind. 3 (1846) 58; Prain in Journ. As. Soc. Beng. 66[2] (1897) 142.

Karoland, Bintang Mariah, *Bartlett & La Rue 128*, June 7, 1918, with the local name *gambir gambir*.

Chittagong, Burma, Perak, Java, and Luzon.

DESMODIUM ZONATUM Miq. Fl. Ind. Bat. 1[1] (1855) 250; Gagnep. in Not. Syst. 3 (1916) 297.

Karoland, Sarinambah, *Bartlett & La Rue 145*, June 8, 1918.

This species extends from Ceylon to the Philippines and New Guinea and in most recent literature appears as *Desmodium ormocarpoides* DC. The latter is, however, an entirely different species, as Gagnepain has shown.

DESMODIUM LASIOCARPUM (Beauv.) DC. Prodr. 2 (1825) 328.

Hedysarum lasiocarpum Beauv. Fl. Oware et Benin 1 (1804) 32, *t. 18*.

Desmodium latifolium DC. Prodr. 2 (1825) 328.

Karoland, Soesoek, *Bartlett & La Rue 321*, July 8, 1918, with the local name *gambir gambir*.

A common and widely distributed species in the tropics of the Old World.

MIMOSA Linnaeus

MIMOSA INVISA Mart. in Flora 20[1] (1837) Beibl. 121.

Asahan, Kampong Silau Meradja, *Bartlett & La Rue 394*, October 24, 1918, with the local name *si madoeridoeri*.

A native of Brazil, introduced here.

PITHECOLOBIUM Martius

PITHECOLOBIUM JIRINGA (Jack) Prain in Journ. As. Soc. Beng. 66[2] (1897) 267, in nota.

Mimosa jiringa Jack in Malay. Miscel. 1[1] (1820) 14.

Inga jiringa Jack op. cit. 2[7] (1822) 78.

Pithecolobium lobatum Benth. in Hook. Lond. Journ. Bot. 3 (1844) 208.

Asahan, Silau Meradja, *Bartlett & La Rue 148, 417*, June and October, 1918, with the local names *djering* and *djaring*.

The earlier names *Mimosa keoringa* Roxb. and *M. djiringa* Roxb., both proposed by Roxburgh in 1814, are *nomina nuda*, although Roxburgh published a description of the former in 1832. Jack's specific name should be adopted for this Malayan species which extends from Tenasserim to Java and Borneo, but which does not extend to the Philippines.

MELIACEAE

CIPADESSA Blume

CIPADESSA BACCIFERA (Roth) Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 6.

Melia baccifera Roth Nov. Pl. Sp. (1821) 215.

Karoland, Bintang Mariah, *Bartlett & La Rue 326*, August 10, 1918, with the local name *koendoelen pamal.*

Ceylon to Java and the Philippines.

EUPHORBIACEAE

SUMBAVIOPSIS J. J. Smith

SUMBAVIOPSIS ALBICANS (Blume) J. J. Sm. in Meded. Dept. Landbouw 10 (1910) 357; Pax in Engl. Pflanzenreich 57 (1912) 14.

Adisca albicans Blume Bijdr. (1825) 611.

Karoland, Kampong Bintang Mariah, *Bartlett & La Rue 131*, June 7, 1918, with the local name *sempaling.*

A monotypic genus, the species now being known from Sumatra, Java, and Palawan.

CELASTRACEAE

PERROTTETIA Humbolt, Bonpland, and Kunth

PERROTTETIA ALPESTRIS (Blume) Loesen. in Engl. & Prantl Nat. Pflanzenfam. 3[5] (1892) 220; Koord. & Val. in Ic. Bogor. 2 (1904) 137, *t. 127.*

Celastrus alpestris Blume Bijdr. (1826) 1145.

Karoland, Sinaboen, *Bartlett & La Rue 218*, June 30, 1918, in mountain jungle.

Java, Borneo, and the Philippines.

RHAMNACEAE

ZIZYPHUS Jussieu

ZIZYPHUS CALOPHYLLA Wall. in Roxb. Fl. Ind. 2 (1824) 366.

Asahan, Silau Meradja, *Bartlett & La Rue 407*, October 27, 1918, with the local name *si silan niboet.*

Penang, Malay Peninsula, Singapore, Bangka (*Zizyphus ornata* Miq.).

VITACEAE

LEEA Royen

LEEA INDICA (Burm. f.) comb. nov.

Staphylea indica Burm. f. Fl. Ind. (1768) 75, *t. 23, f. 2.*
Aquilicia sambucina Linn. Mant. 2 (1771) 211.
Leea sambucina Willd. Sp. Pl. 1 (1797) 1177.

Asahan, Boenoet, *Bartlett & La Rue 48*, May 17, 1918, with the local name *pubentjil.*

This species is widely distributed in the Indo-Malayan region, Burman's type apparently being a Javan specimen. It is currently known as *Leea sambucina* (Linn.) Willd., but Burman's name being the older should be adopted. The Linnean binomial is apparently typified by Burman's figure and description, *Staphylea indica* Burm. f. being cited by Linnaeus as a synonym of his species; there is no specimen in the Linnean herbarium.

MALVACEAE

HIBISCUS Linnaeus

HIBISCUS MACROPHYLLUS Roxb. Hort. Beng. (1814) 51, *nomen nudum;* DC. Prodr. 1 (1824) 455.

Karoland, Soesoek, *Bartlett & La Rue 209*, June 30, 1918, with the local name *anoek anoek.*

India, Penang, Perak, Java.

SIDA Linnaeus

SIDA CORYLIFOLIA Wall. Cat. (1829) No. 1865, *nomen nudum;* Mast. in Hook. f. Fl. Brit. Ind. 1 (1874) 324.

Karoland, Kampong Lingga, *Bartlett & La Rue 149*, with the local name *oeboeng oeboeng;* Asahan, Kampong Silau Meradja, *Bartlett & La Rue 339*, with the local name *tamba loea.*

Burma, Indo-China, Hainan, Java, Madura, Boeton, Philippines; not recorded from the Malay Peninsula.

WISSADULA Medicus

WISSADULA PERIPLOCIFOLIA (Linn.) Thwaites Enum. Pl. Zeyl. (1859) 27.

Sida periplocifolia Linn. Sp. Pl. (1753) 684.

Asahan, Silau Meradja, *Bartlett & La Rue 340*, October 10, 1918, with the local name *boeloeng boeloeng pagar.*

A widely distributed tropical species not previously recorded from Sumatra.

STERCULIACEAE

FIRMIANA Marsigli

FIRMIANA COLORATA (Roxb.) R. Br. in Benn. Pl. Jav. Rar. (1844) 235.

Sterculia colorata Roxb. Pl. Coromandel 1 (1795) 26, *t.* 25.

Karoland, Kampong Goenoeng Merlawan, *Bartlett & La Rue 206*, June 28, 1918, with the local name *tjipa tjipa*.

India, Ceylon, and the Andaman Islands.

FLACOURTIACEAE

OSMELIA Thwaites

OSMELIA BARTLETTII sp. nov.

Frutex vel arbor, ramulis inflorescentiisque pubescens; foliis chartaceis oblongo-ellipticis, 7 ad 9 cm longis, glabris vel subtus ad costa nervisque leviter pubescentibus, acuminatis, nervis utrinque 4, curvatis, perspicuis; inflorescentiis paniculatis, ramis paucis, spiciformibus, elongatis; floribus 4-meris.

A shrub or tree, nearly glabrous except the pubescent younger parts and inflorescences. Branches terete, glabrous, grayish, the branchlets rather densely pubescent with subferrugineous hairs. Leaves chartaceous, oblong-elliptic, 7 to 9 cm long, 3.5 to 4.5 cm wide, entire, brownish-olivaceous when dry, the lower surface paler, base usually acute, sometimes obtuse, apex shortly acuminate, the upper surface entirely glabrous, the lower surface glabrous or obscurely pubescent on the midrib and nerves; lateral nerves usually 4 on each side of the midrib, distinct, prominently curved, not anastomosing, the reticulations slender, subparallel; petioles about 1 cm long, more or less pubescent. Panicles axillary, and terminating lateral leafy branchlets, the leaves on these branchlets much smaller than the normal ones, 2 to 3 cm long, the branches of the inflorescence few, simple, up to 10 cm in length, pubescent. Flowers subsessile, usually scattered, never glomerate, about 5 mm in diameter, 4-merous, their pedicels 1 mm long or less. Sepals 4, oblong-elliptic, obtuse, 3 mm long, slightly pubescent outside. Stamens 8, their filaments slightly pilose, equal, about 2 mm long, the alternating lobes united for the lower 0.8 mm, one lobe alternating with each filament, the free parts oblong-obovate, densely pilose, about 1 mm long; ovary oblong-elliptic, densely pubescent.

SUMATRA, East Coast, Asahan, in deep jungle at Bandar Poelo, *Bartlett & La Rue 37*, May 16, 1918.

This species is apparently most closely allied to *Osmelia maingayi* King, of the Malay Peninsula, and possibly is represented by *Beccari 928* from Sumatra mentioned by King in a note following his description. It is distinguished among all the hitherto described species of the genus by its few-nerved leaves. This small genus, for many years known only from Ceylon and the Philippines, is now represented by 7 or 8 species, the known range of the genus now being Ceylon, Sumatra, Malay Peninsula, Borneo, the Philippines, and Celebes.

MELASTOMATACEAE

MEMECYLON Linnaeus

MEMECYLON LARUEI sp. nov.

Frutex vel arbor parva, ramis teretibus, ramulis 4-angulatis et anguste 4-alatis; foliis coriaceis, lanceolatis, sessilibus vel subsessilibus, usque ad 20 cm longis et 5.5 cm latis, basi rotundatis, plerumque subcordatis, sursum angustatis, tenuiter acute acuminatis, nervis utrinque circiter 15, rectis, perspicuis, cum nervis marginalibus anastomosantibus; inflorescentiis axillaribus, solitariis, paniculatis, longe pedunculatis, 10 ad 15 cm longis.

A glabrous shrub or small tree, the branches terete, about 3 mm in diameter, the branchlets sharply 4-angled and narrowly winged, the wings not appendiculate at the nodes, the internodes 4 to 5 cm long. Leaves coriaceous, lanceolate, sessile or subsessile, base rounded and usually slightly cordate, gradually narrowed upward to the long, slenderly acuminate apex, 14 to 20 cm long, 3 to 5.5 cm wide, usually shining, the midrib impressed on the upper surface, very prominent on the lower surface; primary lateral nerves about 15 on each side of the midrib, distinct on the lower surface, anastomosing with the equally prominent, slightly arched, marginal nerves, 2.5 to 5 mm from the edge of the leaf, reticulations obsolete. Inflorescences axillary, solitary, long-peduncled, paniculate, 10 to 15 cm long, the branches few, opposite, spreading, the lower ones up to 4 cm long, usually sulcate. Flowers subumbellately arranged at the tips of the branchlets, their pedicels about 3 mm long, each subtended by several, lanceolate, acuminate, 1 mm long bracteoles, the bracts subtending the branches similar to the bracteoles but twice as long. Calyx shallowly cup-shaped, 2.5 to 3 mm in diameter, somewhat 4-toothed. Petals obliquely and broadly ovate, about 2 mm long.

SUMATRA, East Coast, Asahan, in second-growth jungle at Lau Boeloeh, *Bartlett & La Rue 236*, July 1, 1918.

This species belongs in the group with *Memecylon appendiculatum* Blume, *M. paniculatum* Jack and *M. costatum* Miq. and perhaps is most closely allied to Jack's species, the type of which was from Sumatra. It is well characterized by its lanceolate leaves, which are more or less gradually narrowed upward from the lower one-third to the slenderly and sharply acuminate apex.

ERICACEAE

VACCINIUM Linnaeus

VACCINIUM HASSELTII Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863–64) 40.

Near Balige Taba, *Bartlett & La Rue 497*, October 4, 1918. Malay Peninsula, Singapore, Bangka.

CLETHRACEAE

CLETHRA Linnaeus

CLETHRA SUMATRANA J. J. Sm. in Ic. Bogor. 4 (1910) *t. 319.*

Near Balige Taba, *Bartlett & La Rue 496*, October 4, 1918. The second collection of this endemic species.

EBENACEAE

DIOSPYROS Linnaeus

DIOSPYROS WALLICHII King & Gamble in Journ. As. Soc. Beng. 74[2] (1905) 220.

Asahan, Silau Meradja, *Bartlett & La Rue 345*, October 11, 1918, with the local name *boea sahoepang.*

Widely distributed in the Malay Peninsula but hitherto not reported from elsewhere.

APOCYNACEAE

PARAMERIA Bentham

PARAMERIA BARBATA (Blume) K. Schum. in Engl. & Prantl Nat. Pflanzenfam. 4[2] (1895) 162.

Parsonsia barbata Blume Bijdr. (1826) 1042.

Karoland, Kampong Singga Manik, *Bartlett & La Rue 155*, June 14, 1918.

Burma and Indo-China southward and eastward to Java, the Philippines, and the Moluccas; it is more commonly known as *Parameria glandulifera* Benth.

VERBENACEAE

PREMNA Linnaeus

PREMNA PYRAMIDATA Wall. Cat. (1829) No. 1779, *nomen nudum;* Schauer in DC. Prodr. 11 (1847) 633.

Asahan, Boenoet, *Bartlett & La Rue 46*, May 17, 1918.
Burma to the Malay Peninsula, Java, and Timor.

CLERODENDRON Linnaeus

CLERODENDRON PANICULATUM Linn. Mant. 1 (1767) 90.

Asahan, Silau Meradja, *Bartlett & La Rue 406*, with the local name *si panggil.*

Formosa, Hainan, Indo-China, Siam, and the Malay Peninsula. It is of interest to note that the allied Philippine species, *Clerodendron intermedium* Cham., is currently known to the Tagalogs by a similar name, *casopanguil.*

CALLICARPA Linnaeus

CALLICARPA BREVIPETIOLATA sp. nov.

Frutex vel arbor parva, ramulis et subtus foliis densissime stellato-tomentosis; foliis chartaceis, lanceolatis, brevissime petiolatis, usque ad 10 cm longis, basi abrupte lateque rotundatis et distincte cordatis, apice tenuiter acuminatis, margine dentatis, nervis utrinque 10 ad 12; cymis axillaribus, breviter pedunculatis, sub fructu confertis, subglobosis, 1 ad 2 cm diametro.

A shrub or a small tree, the branchlets and lower surface of the leaves very densely and uniformly stellate-tomentose, the indumentum pale brownish, eglandular, the branchlets terete, 1.5 to 2 mm in diameter. Leaves lanceolate, chartaceous, brittle when dry, 7 to 10 cm long, 1.5 to 2.5 cm wide, the upper surface brownish olivaceous, more or less pubescent with short simple hairs, the base abruptly and broadly rounded, distinctly cordate, narrowed upward to the slenderly acuminate apex, the margins rather finely dentate; lateral nerves 10 to 12 on each side of the midrib, not prominent; petioles densely stellate-tomentose, 1 to 2 mm long. Cymes axillary, solitary, stellate-tomentose, peduncled, the peduncles 5 to 10 mm long, in fruit dense, subglobose, 1 to 2 cm in diameter. Fruits very numerous, crowded, globose, 2 to 2.5 mm in diameter, black and rugose when dry, the calyces stellate-pubescent, shallow, about 2 mm in diameter, 4-toothed.

SUMATRA, East Coast, Karoland, Kampong Bintang Mariah, *Bartlett & La Rue 323*, August 10, 1918, with the local name *laoe gappa gappa.*

The alliance of this species is manifestly with *Callicarpa rubella* Lindl., from which it is especially distinguished by its very dense stellate-tomentose indumentum, which completely covers the lower surfaces of the leaves.

RUBIACEAE

LASIANTHUS Jack

LASIANTHUS OBLONGUS King & Gamble in Journ. As. Soc. Beng. 73[4] (1904) 127.

Karoland, Sinaboeŋ, *Bartlett & La Rue 212*, June 30, 1918.

Malay Peninsula.

LASIANTHUS RHINOCEROTIS Blume Bijdr. (1826) 996.

Karoland, Kampong Bintang Mariah, *Bartlett & La Rue 325*, August 10, 1918.

Malay Peninsula, Java.

TARENNA Gaertner

TARENNA MOLLIS (Wall.) Valeton in Engl. Bot. Jahrb. 44 (1910) 558, quoad syn. excl. spec. cit.

Stylocoryna mollis Wall. Cat. (1848) No. 8454, *nomen nudum.*
Webera mollis Hook. f. Fl. Brit. Ind. 3 (1880) 104.

Asahan and Karoland, Kaban Djahe, *Bartlett & La Rue 17, 89*, May and June, 1918, with the local name *djaroem djaroem.*

Malay Peninsula. The Bornean specimens originally referred to this species by Valeton represent the allied *Tarenna winkleri* Valeton. *Webera sumatrana* Boerl.[5] is probably referable to the genus *Pavetta.*

COMPOSITAE

BLUMEA De Candolle

BLUMEA PUBIGERA (Linn.) comb. nov.

Conyza pubigera Linn. Mant. 1 (1767) 113.
Blumea chinensis DC. Prodr. 5 (1836) 444, non *Conyza chinensis* Linn.
Conyza riparia Blume Bijdr. (1826) 699.
Blumea riparia DC. Prodr. 5 (1836) 444.

Asahan, Silau Meradja, *Bartlett & La Rue 452*, November 9, 1918.

The type of *Conyza pubigera* Linn. was a specimen grown at Upsala, the description conforming closely with the characters of this species currently known as *Blumea chinensis* DC. *Sonchus volubilis* Rumph.,[6] cited by Linnaeus as a synonym of *Conyza pubigera,* is a good representation of the species under consideration. The type of *Conyza chinensis* Linn., the name-bringing synonym of *Blumea chinensis* DC., was a specimen from China, collected by Toren, and the short original description clearly does not apply to the species currently called *Blumea chinensis* DC. The species, as here interpreted, extends from southern China and Formosa to the Malay Peninsula, Sumatra, Java, Borneo, the Philippines, and the Moluccas.

[4] In Veth Midden-Sumatra 4 pt. 2 (1884) 21, *t. 2.*
[6] Herb. Amb. 5:299, *t. 103, f. 2.*

REVIEWS

Information | for the | Tuberculous | by | F. W. Wittich, A. M., M. D. | instructor in medicine and physician in charge tuberculosis | dispensary, University of Minnesota Medical School; | visiting physician, University Hospital, | Minneapolis, Minnesota | St. Louis | C. V. Mosby Company | 1918 | pp. 1–150, including index. Cloth, $1.

Mental Diseases | A Handbook Dealing with | Diagnosis and Classification | by | Walter Vose Gulick, M. D. | assistant superintendent Western State Hospital, | Fort Steilacoom, Washington | Illustrated | St. Louis | C. V. Mosby Company | 1918 | pp. 1–142, including index. Cloth, $2.

The Anatomy | of the | Domestic Fowl | by | B. F. Kaupp, M. S., D. V. M. | poultry investigator and pathologist in the North Carolina | Experiment Station, State Department of Agriculture, and the | State College of Agriculture; formerly director of anatomy | Laboratory, Kansas City Veterinary College | Illustrated | Philadelphia and London | W. B. Saunders Company | 1918 | pp. 1–373, including index. Cloth.

An Outline | of the | History of Phytopathology | by | Herbert Hice Whetzel | professor of plant pathology at Cornell University | Ithaca, New York | With 22 Portraits |-Philadelphia and London | W. B. Saunders Company | 1918 | pp. 1–130, including index. Cloth.

THE PHILIPPINE BUREAU OF SCIENCE

RECENT PUBLICATIONS

AN INTERPRETATION OF RUMPHIUS'S HERBARIUM AMBOINENSE

By E. D. MERRILL

Based on the collections made in Ambolna by the late Charles Budd Robinson

Order No. 450. Bureau of Science Publication No. 9. Paper, 595 pages and 2 maps.

Price, $3 United States currency, postpaid.

SPECIES BLANCOANAE: A CRITICAL REVISION OF THE PHILIPPINE SPECIES OF PLANTS DESCRIBED BY BLANCO AND BY LLANOS

By E. D. MERRILL

Order No. 461. Bureau of Science Publication No. 12. Paper, 423 pages and 1 map.

Price, $2.25 United States currency, postpaid.

PHILIPPINE WATER SUPPLIES

By George W. Heise and A. S. Behrman

Order No. 460. Bureau of Science Publication No. 11. Paper, 218 pages, 19 plates, and 4 text figures.

Price, $1.75 United States currency, postpaid.

A GRAMMAR OF LEPANTO IGOROT AS IT IS SPOKEN AT BAUCO

By MORICE VANOVERBERG

Order No. 438. Vol. V, Part VI, Division of Ethnology Publications. Paper, 102 pages.

Price, $0.75 United States currency, postpaid.

This part completes Volume V of the Division of Ethnology publications and includes the index and the title-page for the volume. A title-page for Volume II is printed with this number.

PLEASE GIVE ORDER NUMBER

Orders for these publications may be sent to the Business Manager, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the following agents:

AGENTS

THE MACMILLAN COMPANY, 64-66 Fifth Avenue, New York, U. S. A.
WM. WESLEY & SON, 28 Essex Street, Strand, London, W. C., England.
MARTINUS NIJHOFF, Lange Voorhout 9, The Hague, Holland.
KELLY & WALSH, Limited, 32 Raffles Place, Singapore, Straits Settlements.
THACKER, SPINK & CO., P. O. Box 54, Calcutta, India.
THE MARUZEN CO., Limited, 11-16 Nihonbashi, Tori-Sanchome, Tokyo, Japan.

CONTENTS

	Page.
BANKS, CHARLES S. Phlebotomus nicnic, a new species, the first Philippine record for this genus	163
BANKS, CHARLES S. The bloodsucking insects of the Philippines	169
COCKERELL, T. D. A. The Prosopidæ, or obtuse-tongued bees, of the Philippine Islands	191
COCKERELL, T. D. A. The Philippine bees of the families Anthophoridæ and Melectidæ	195
CARREON, MARCIANO. The absence of both hind legs below the femur in a full-term pig	201
HAUGHWOUT, FRANK G., and DE LEON, WALFRIDO. On the ingestion of erythrocytes by Pentatrichomonas sp., found in a case of dysentery	207
WITT, J. C. The effect of calcium sulphate on cement: Second paper	221
PANGANIBAN, C. S., and SCHÖBL, O. Experience with methylene blue-eosin lactose agar in searching for Bacillus dysenteriæ in stools	235
MERRILL, E. D. Notes on the flora of Sumatra	239
REVIEWS	251

The Philippine Journal of Science is issued twelve times a year. The sections were discontinued with the completion of Volume XIII (1918).

Yearly subscription, beginning with Volume XIV, 5 dollars United States currency. Single numbers, 50 cents each.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

Entered at the post office at Manila, P. I., as second-class matter.